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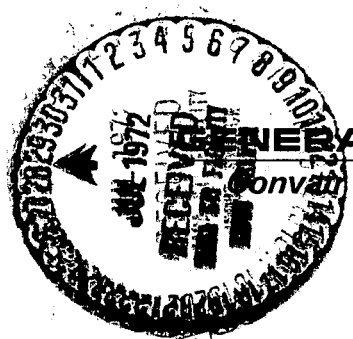
LIFE SCIENCES PAYLOAD DEFINITION AND INTEGRATION STUDY

VOLUME III • APPENDICES



GENERAL DYNAMICS
Convair Aerospace Division

242

REPORT NO. GDC-DBD72-002

LIFE SCIENCES PAYLOAD DEFINITION AND INTEGRATION STUDY

VOLUME III • APPENDICES

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GEORGE C. MARSHALL SPACE FLIGHT CENTER
Huntsville, Alabama

Prepared by
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TABLE OF CONTENTS

APPENDIX I

CONFIGURATION STUDIES DATA

This appendix contains detail design information on the following:

a. Equipment modules/equipment item lists

b. Weight and volume breakdown by payload and equipment units (EUs)

c. Layouts made for first generation designs

d. External centrifuge for Maxi Max laboratory

e. The Midi-30 payload definition

f. Longitudinal floor arrangement configuration

g. Non baseline second generation layouts.

I. 1 EQUIPMENT MODULES

Figures I-1 through I-22 depict the equipment racks (ERs); equipment consoles (ECs); and special equipment modules (SEMs) developed for the second generation layouts. These equipment modules were used in the development of the baseline payloads.

In determining the number of modules required to hold the equipment items (EIs) a sizing study was performed on the pertinent CORE equipment units. Figures I-1 through I-6 indicate the results of a preliminary EI placement activity. The EI placement within the equipment unit (EU) is noted by the EI identification number. The EI placement activity had two purposes: (1) to represent a first-cut functional placement relationship of equipment; and (2) to provide equipment module sizing and volume requirements for the payload layout design task.

The figures illustrate the size and shape of the various equipment modules for the various baseline payloads. The accompanying tables itemize the individual equipment items contained within each equipment module.

The standard module has a 0. 61 m by 0. 61 m base and is 2. 0 meters high. Two exceptions are the cage module holding units and the internal centrifuge.

The BLH units (SEMs) are descrete designs whose configuration was dictated by the various functions (i. e. , bicycle ergometer, rotating litter chair, etc.).

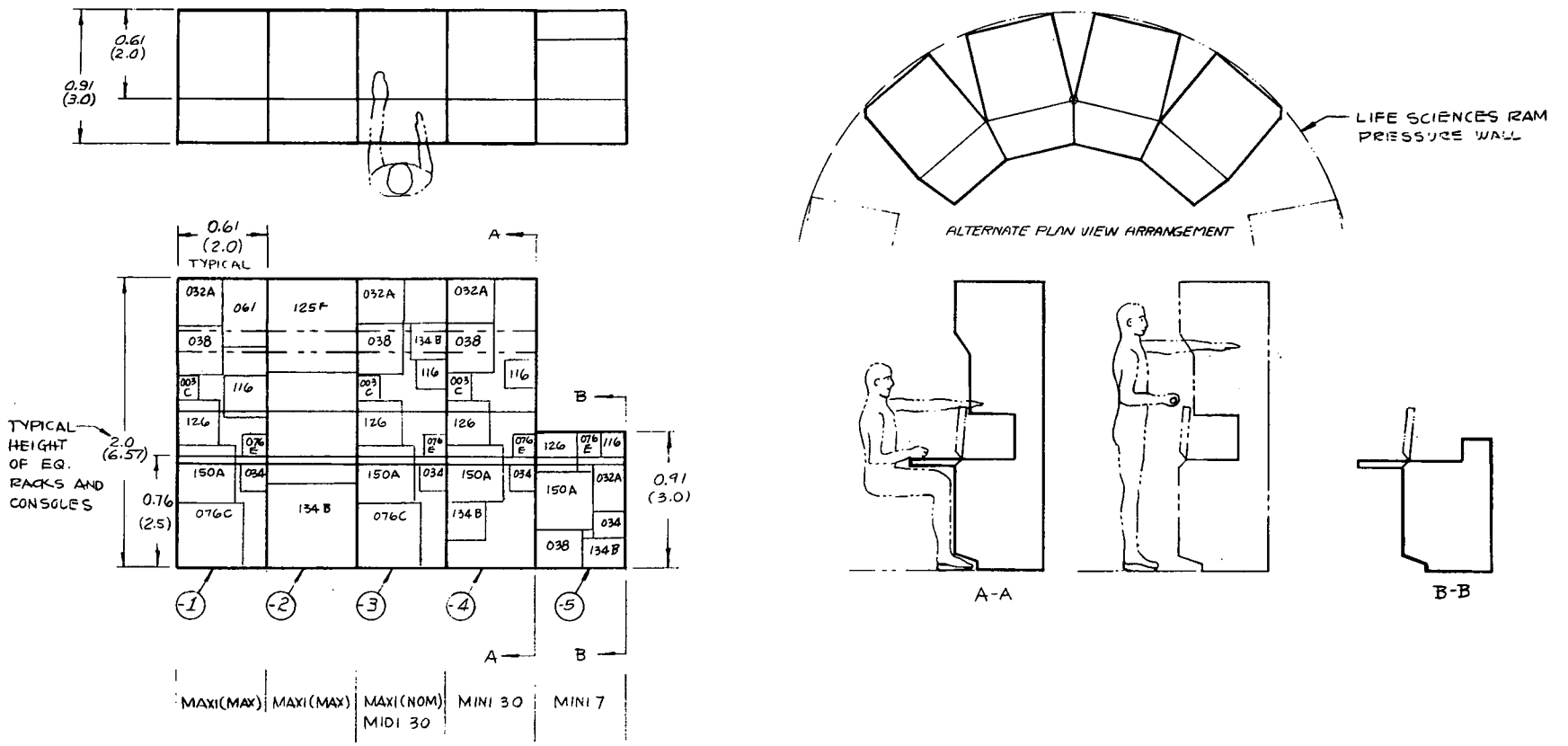


Figure I-1. Equipment Unit EU 001 Visual Records and Microscopy Unit (Sheet 1)

EI NO.	NAME	MAXI MAX	MAXI NOM	MIDI 30	MINI 30	MINI 7	REMARKS
003C	Adapters, TV-Microscope	1	1	1	1	-	
032	Camra, Cine	32	10	10	6	4	
		(Distributed throughout laboratory)					
032A	Camera Controller	2	2	2	1	1	
034	Camra, Stil, (Plate,	2	2	2	2	2	
037	Camra, Video B/W	93	41	41	13	5	
		(Distributed throughout laboratory)					
038	Camra, Video/Color	1	1	1	1	1	
038A	Camera X-Y Drive	104	28	28	4	1	
		(Part of CM)					
061	Densitomtr, X-ray	1	-	-	-	-	
076C	Film	4	4	-	-	-	
076E	Filters, Video	1	1	1	1	1	
116	Log Books for Daily Records	30	14	14	11	11	
125F	Microscope-Holographic	1	-	-	-	-	
126	Micrscp, Compnd	1	1	1	1	1	
126E	Mirror Mount Commutator	102	28	28	4	1	
126G	Monitor, Video	6	3	2	1	1	
		(Distributed throughout laboratory)					
134B	Paper, Recording	7	3	3	3	3	
150A	Rcrdr Multichn Biomed	1	1	1	1	-	
181E	Video ID Date-Time Sys	1	1	1	1	1	

Figure I-1. Equipment Unit EU 001 Visual Records and Microscopy Unit (Sheet 2)

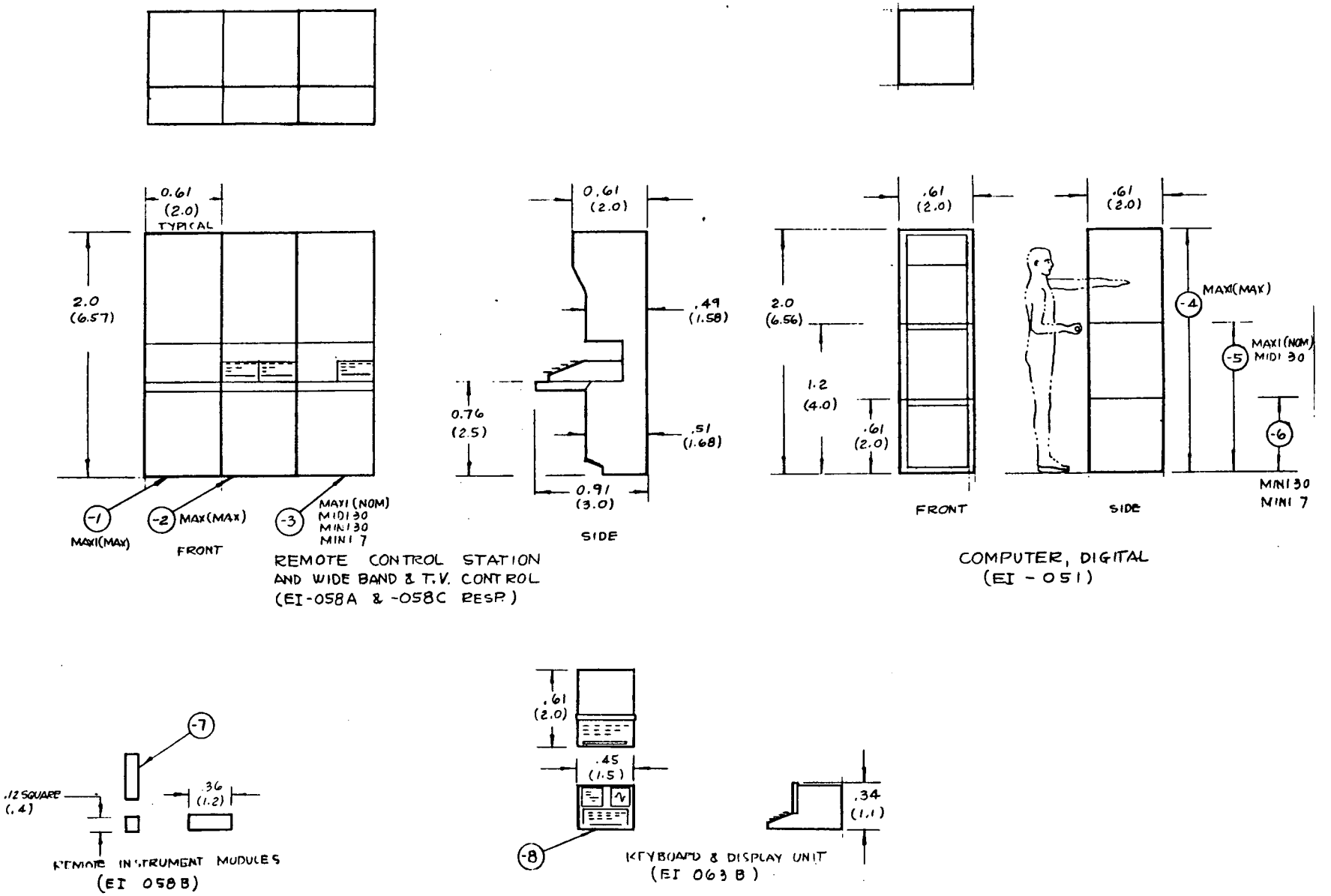


Figure I-2. Equipment Unit EU-002-Data Management Unit (Sheet 1)

EI NO.	NAME	MAXI MAX	MAXI NOM	MIDI 30	MINI 30	MINI 7	REMARKS
014B	Antennas, Assorted	4	1	1	1	-	
051	Computer, Digital	1	1	1	1	1	
051A	Converter, A-D	1000 (In CM)	-	-	-	-	
056A	Data Mngmt Sys Buses	1 (Distributed throughout laboratory)	1	1	1	1	
058	Data Ms, Plot/Print	3	2	2	1	1	
058A	Data Mngmt Syst, Re-	4 (Part in R.C.)	2	1	1	1	
058B	Data Mngmt Sys	30	12	12	4	3	
058C	Data Mngmt Syst, Wide	1	1	1	1	1	
063B	Display-Keybrd, Int, Prt	7 (Distributed throughout laboratory)	4	4	2	2	
064	Egg Couplr	134 (Distributed throughout laboratory CM & Subjects)	36	36	12	12	
065	Egg Couplr	34 (Distributed throughout laboratory CM & Subjects)	12	8	4	-	
066	Emg Couplr	32 (Distributed throughout laboratory CM & Subjects)	32	16	6	-	
132	Oscilscpe (OC-5MHZ)	2	2	1	1	-	
150F	Rcrdr, Electm, 100-5MHZ	1	-	-	-	-	
150G	Rcrdr, Electm, 0-100HZ	1	-	-	-	-	
156	Signl Cond (Couplr)	1730 (Distributed throughout laboratory)	595	595	105	44	
176	Tape, Video	10	5	1	1	1	
180	Timer, Event	2	2	2	2	2	

Figure I-2. Equipment Unit EU-002-Data Management Unit (Sheet 2)

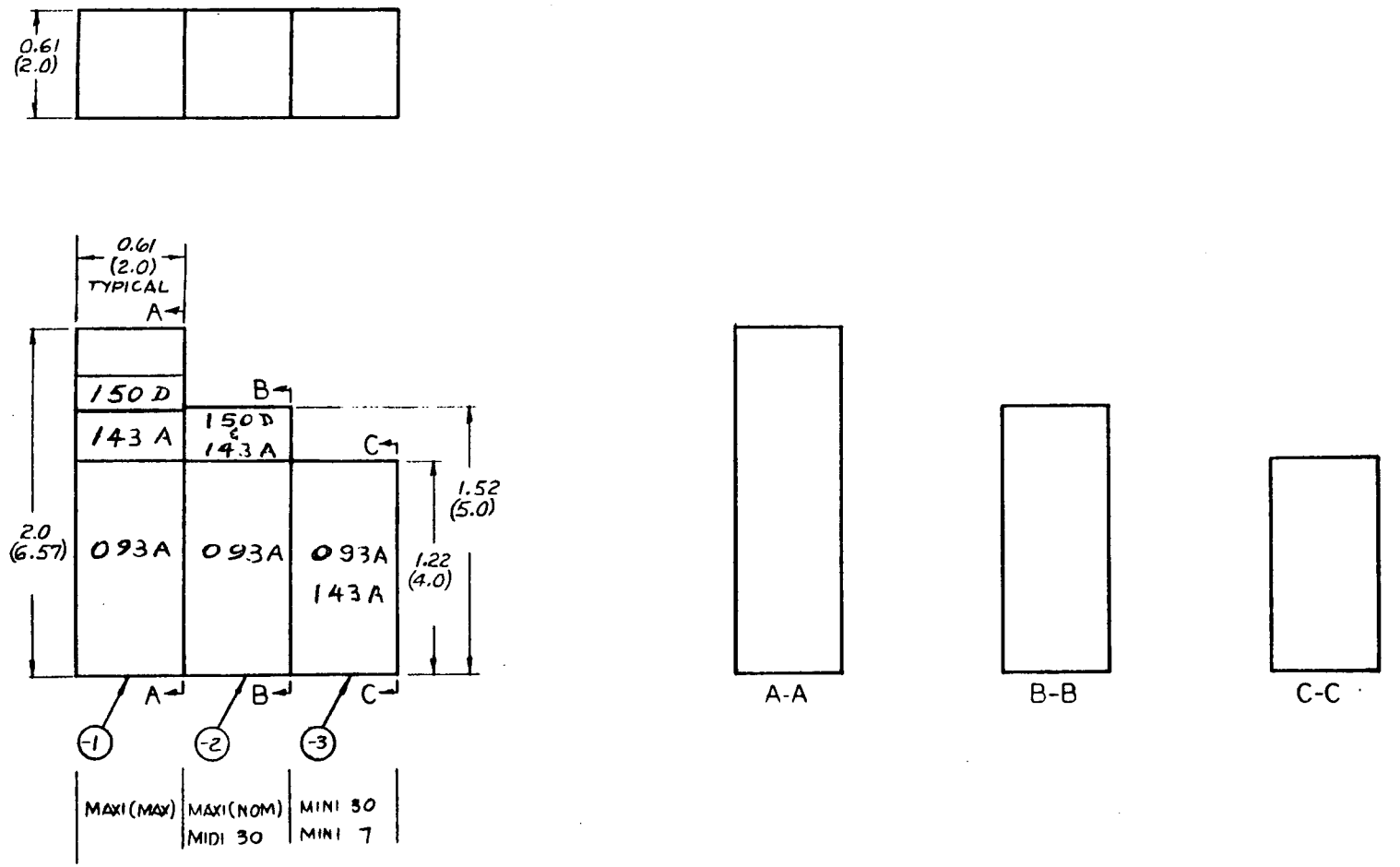
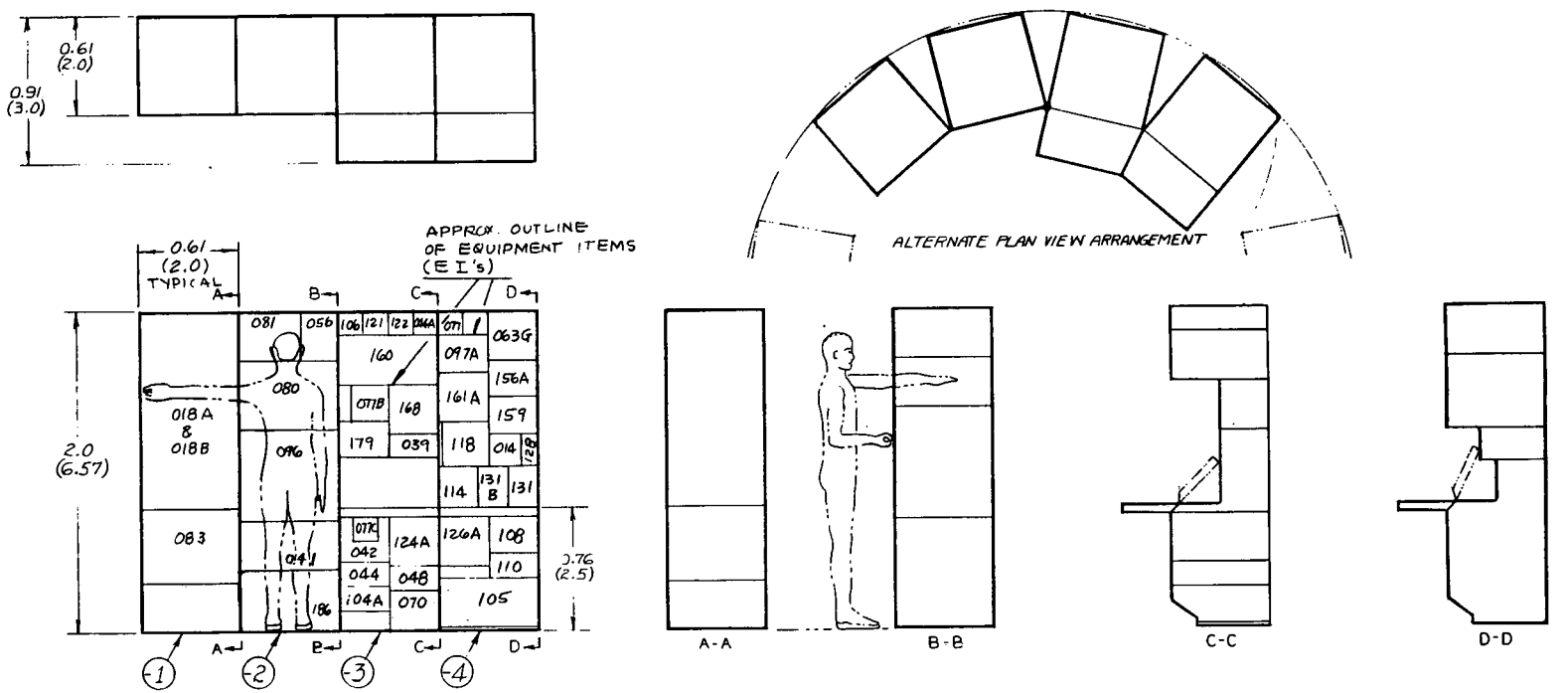


Figure I-3. Equipment Unit EU 003 Life Sciences Experiment Support Unit (Sheet 1)

EI NO.	NAME	MAXI MAX	MAXI NOM	MIDI 30	MINI 30	MINI 7	REMARKS
001	Accelerometr (Activity)	39	17	17	7	5	
		(Distributed throughout laboratory)					
001A	Accelerometr Coupler	45	17	17	7	5	
		(Distributed throughout laboratory)					
055A	Crew Mobility Aids	50	29	29	27	24	
		(Distributed throughout laboratory)					
055B	Crew Restraints	50	29	29	27	24	
		(Distributed throughout laboratory)					
076H	Flowmeter Coupler	24	8	8	4	4	
		(Distributed throughout laboratory)					
076J	Flowmeter - Gas	42	20	20	6	-	
		(Distributed throughout laboratory)					
093A	Gas Supply, Assorted	26	20	20	16	8	
143A	Power Supply	2	2	1	1	1	
150D	Receivers Oc-5MHZ	5	3	3	1	-	
187	Waste Mngmt Sys	1	1	1	1	1	
		(Part of animal ECS)					

Figure I-3. Equipment Unit EU 003 Life Sciences Experiment Support Unit (Sheet 2)



MAXI (MAX)
MAXI (NOM)

Figure I-4. Equipment Unit EU 004 Preparation and Preservation Unit (Sheet 1)

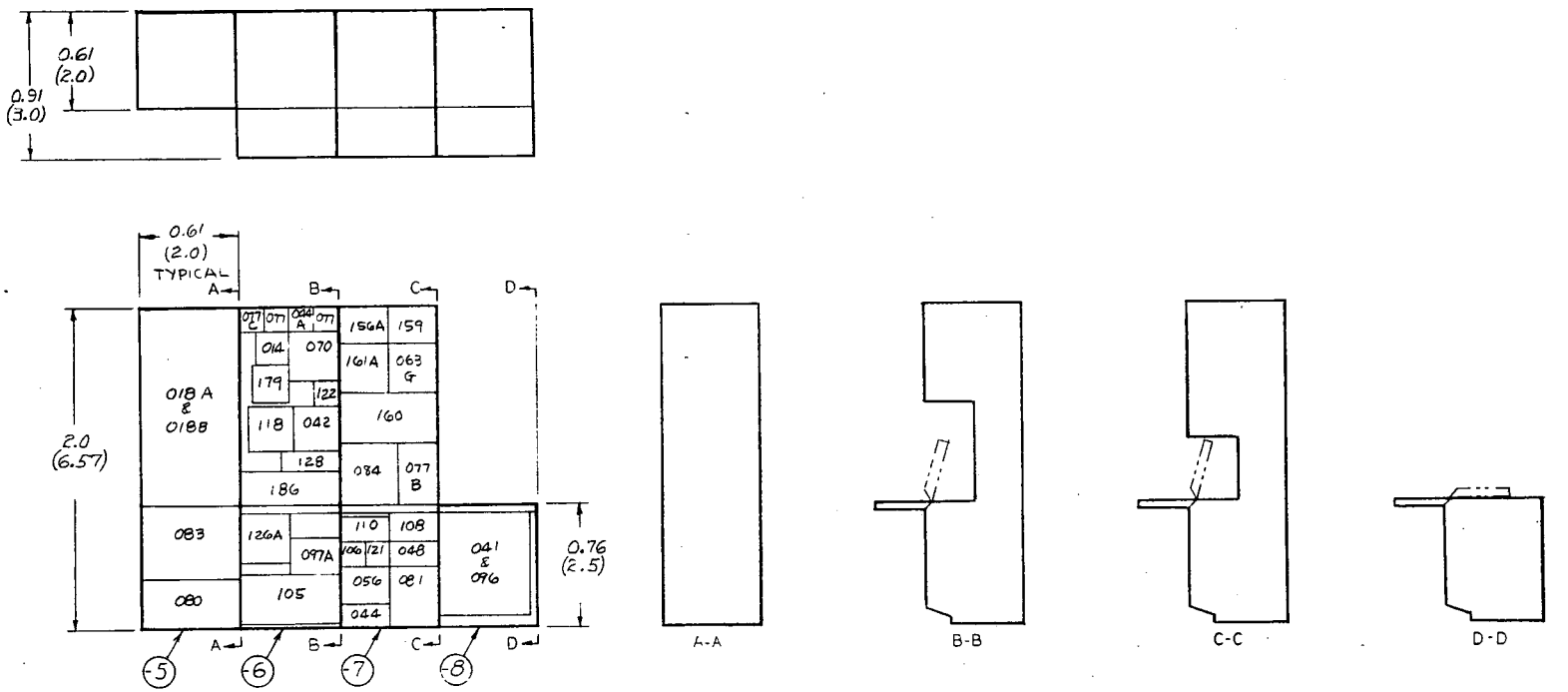
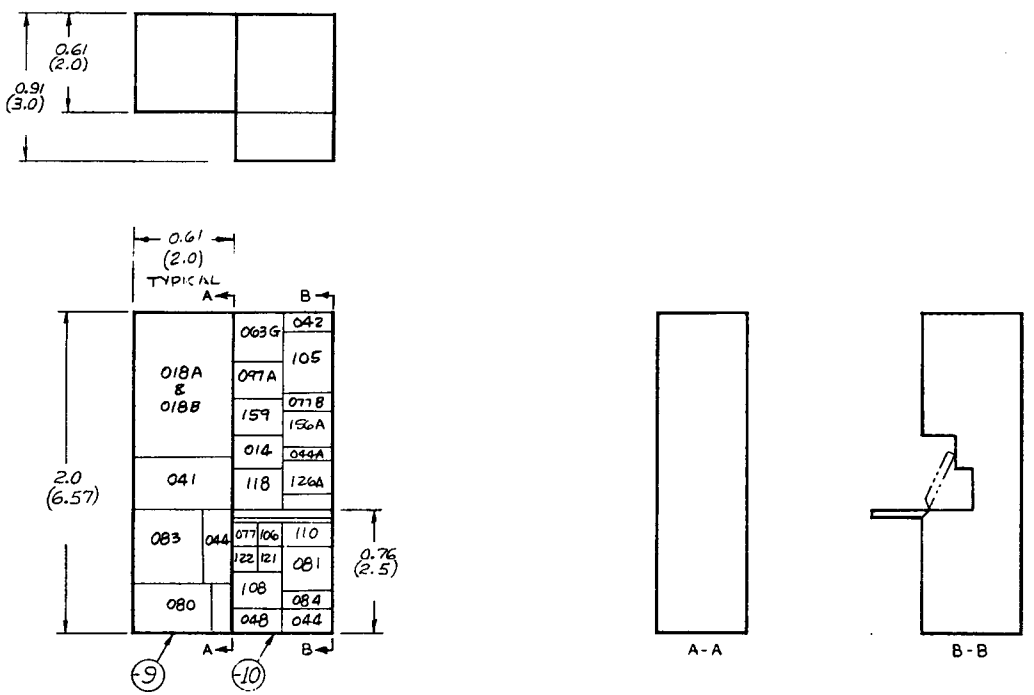
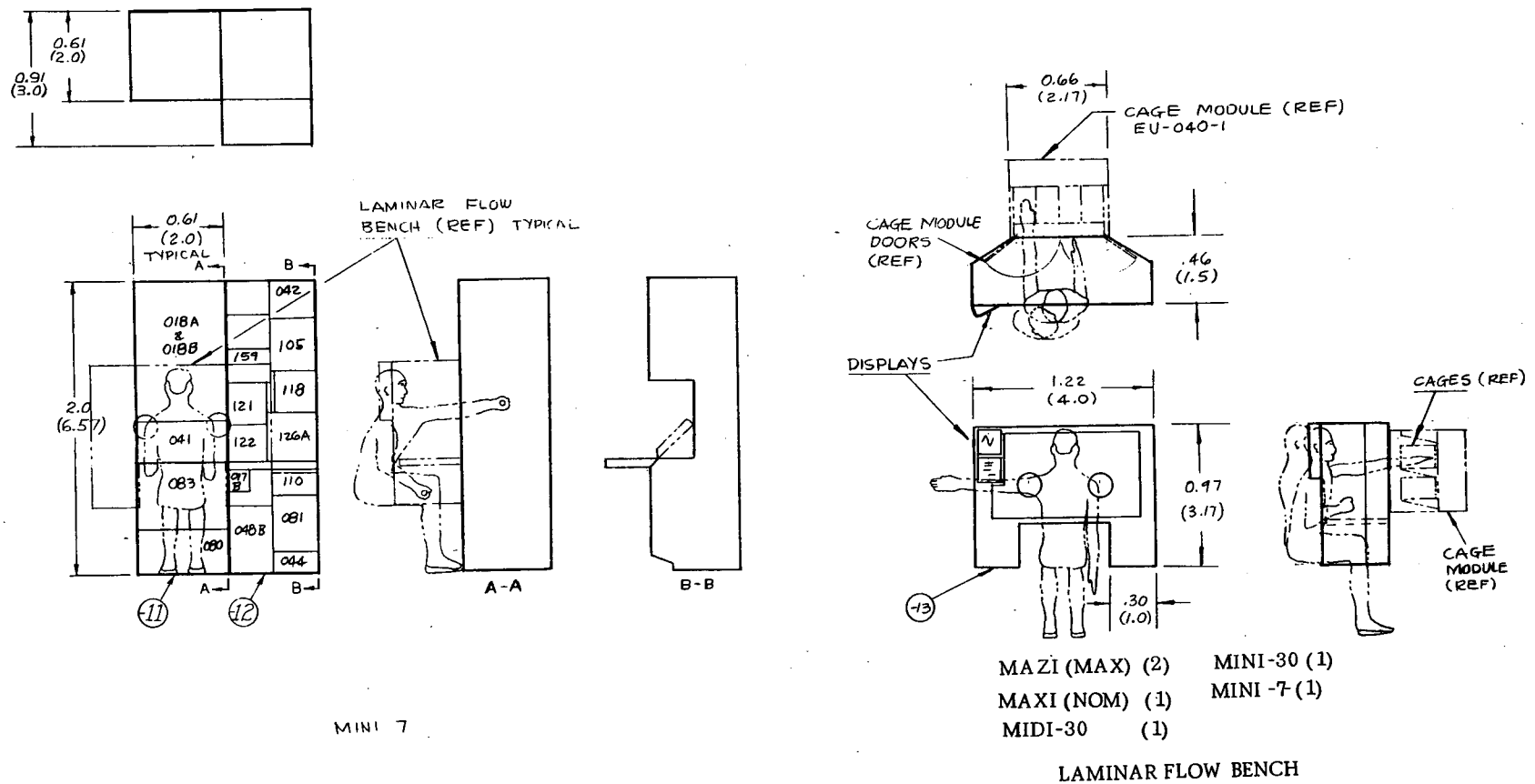


Figure I-4. Equipment Unit EU 004 Preparation and Preservation Unit (Sheet 2)



MINI-30

Figure I-4. Equipment Unit EU 004 Preparation and Preservation Unit (Sheet 3)



PREPARATION AND PRESERVATION UNIT

Figure I-4. Equipment Unit EU 004 Preparation and Preservation Unit (Sheet 4)

EI NO.	NAME	MAXI MAX	MAXI NOM	MIDI 30	MINI 30	MINI 7	REMARKS
014	Anesthetzr (Invert	1	1	1	1	1	
018	Bench, Lam Flo	2	2	1	1	1	
		(Free Body)					
018A	Bench Liners, Lfb	12	6	6	4	4	
018B	Bnch Insert Lfb, Radioc	2	1	1	1	1	
039	Chromatograph, Liquid Column	1	-	-	-	-	
041	Cntrif Frig Hi Spd	1	1	1	1	1	
042	Cntrif Micro	1	1	1	1	1	
044	Chemicals	10	5	3	1	1	
044A	Chemicals-Radioactive	2	1	1	1	1	
048	Cleanr, Vacuum	5	4	2	2	1	
		(Distributed throughout laboratory)					
056	Cryo Sys	1	1	1	-	-	
063G	Deionizer for Pure Water	1	1	1	1	-	
070	Electrophrsis Appar	1	1	1	1	-	
077	Filtr, Chemcls	3	2	2	1	-	
077B	Frezr, Cryo	1	1	1	1	1	
077C	Fragiligraph	1	1	1	1	-	
080	Frezr, Genl	4	2	2	1	1	
081	Frezr, Lo Temp	1	1	1	1	1	
083	Frig	1	1	1	1	1	
084	Frig, Radio Checm Storag	1	1	1	1	1	
096	Glv Bx	1	1	1	-	-	
105	Kit, Bench Chem Anal	1	1	1	1	1	
106	Kit, Hematology	1	1	1	1	-	
108	Kit, Hist	1	1	1	1	1	
110	Kit, Microbiology	1	1	1	1	1	
114A	Kit, Microdissection	1	1	1	1	1	
118	Lyphilzr (Space Vac)	1	1	1	1	1	

Figure I-4. Equipment Unit EU 004 Preparation and Preservation Unit (Sheet 5)

EI NO.	NAME	MAXI MAX	MAXI NOM	MIDI 30	MINI 30	MINI 7	REMARKS
121	Mass Meas, Macro	1	1	1	1	1	
122	Mass Meas, Micro	2	2	1	1	1	
124A	Media Pouring Tble, AG	1	-	-	-	-	
126A	Micrscp, Disecting	1	1	1	1	1	
128	Millipore Filter Apparatus	1	1	1	1	1	
131	Mxer, Chemcls	1	1	-	-	-	
131B	Mortar Pestle and Sand	1	1	-	-	-	
156A	Stain Appartus, Wrights	1	1	1	1	-	
159	Staing Sys, Bacterlgcl	1	1	1	1	1	
160	Stain Sys, (Embd/Rins)	1	1	1	1	-	
161A	Staining Sys, Blants	1	1	1	-	-	
168	Stove	1	1	-	-	-	
179	Temp Block	4	4	3	3	-	
181	Txic Fluid Hndlng Sys	1	1	1	1	-	
186	Volmtrc Meas, Liq	1	1	1	1	-	
097A	Hematocrt Electronic	1	1	1	1	-	
104A	Homogenizers	1	1	-	-	-	

Figure I-4. Equipment Unit EU 004 Preparation and Preservation Unit (Sheet 6)

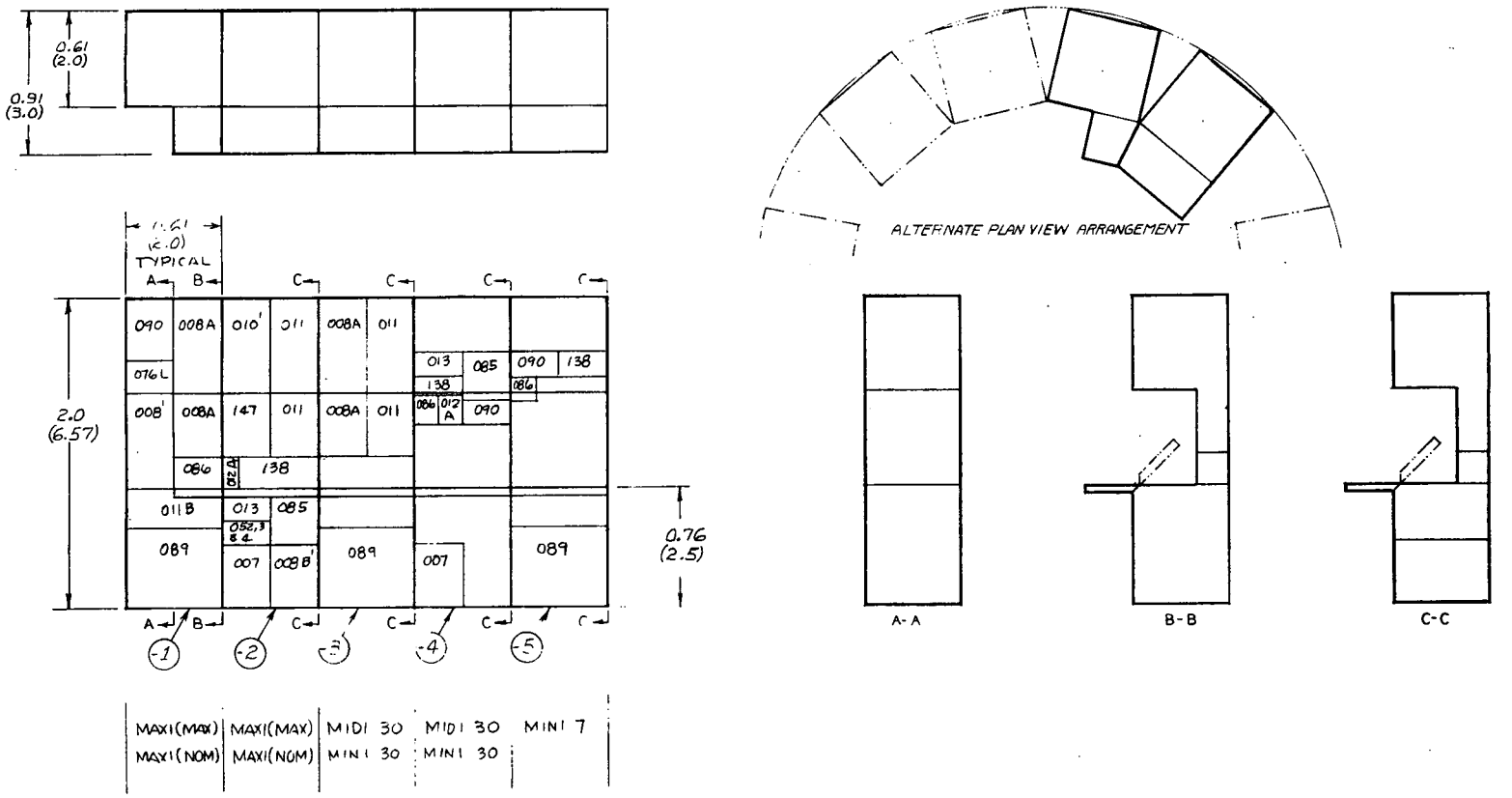


Figure I-5. Equipment Unit EU 005 Biochemical and Biophysics Analysis Unit (Sheet 1)

EI NO.	NAME	MAXI MAX	MAXI NOM	MIDI 30	MINI 30	MINI 7	REMARKS
007	Autoanalyzer, Multiple	1	1	1	1	-	
008	Anlzr, Aminc Acid	1	-	-	-	-	
008A	Anlzr, Atom Ads Sptrph	1	1	1	1	-	
008B	Anlzr, Carbohydrate	1	-	-	-	-	
010	Anlzr, Genl, IR Specph	1	-	-	-	-	
011B	Anlzr, Protein	1	1	-	-	-	
012A	Anlzr, Conductivity	1	1	1	-	-	
013	Anlzr, Urne, Auto	1	1	1	1	-	
015A	Atmos Sampling-Mnfd Sys	10	8	8	1	1	
		(Distribution throughout laboratory)					
016B	Audiometer	2	2	1	1	-	
050A	Commutator, Gas Manifld	6	4	3	1	1	
		(Distribution throughout laboratory)					
052	Countr Cell	1	1	1	1	1	
053	Countr, Colony (Auto)	1	1	1	1	1	
054	Countr, Colony, Manul	1	1	1	-	-	
076L	Fibrometer-Blood Clot	1	1	1	1	-	
085	Gas Anlzr, Auto Physio	1	1	1	1	-	
086	Gas Anlzr, CO_2	2	2	2	1	1	
089	Gas Anlzr, GC (Complx)	1	1	1	1	1	
090	Gas Anlzr, Mas Spec	1	1	1	1	1	
091	Gas Anlzr, Mas Spec	8	3	3	2	2	
		(Distributed throughout laboratory)					
093	Gas Anlzr, RH	4	3	3	1	1	
		(Distributed throughout laboratory)					
118B	Manifld, O_2/CO_2 Msmts	6	3	3	1	1	
		(Distributed throughout laboratory)					
125B	Meters, Assorted	60	21	21	4	4	
125C	Meter, Ao Ts	1	1	1	1	-	

Figure I-5. Equipment Unit EU 005 Biochemical and Biophysics Analysis Unit (Sheet 2)

EI NO.	NAME	MAXI MAX	MAXI NOM	MIDI 30	MINI 30	MINI 7	REMARKS
126B	Microphone	17	8	8	5	4	
		(Distribution throughout laboratory)					
126C	Microphone Amplifier	10	6	6	4	-	
		(Distribution throughout laboratory)					
137	Ph Coupler	20	10	10	-	-	
		(Distribution throughout laboratory)					
138	Ph Mtr	2	2	1	1	1	
143G	Coupler-Pressure Transducr	52	36	26	4	-	
		(at Cage modules)					
147	Radiatn Detectr, Scint	1	1	1	1	1	
157	Sound Level Meter	5	2	2	1	1	
		(Distribution throughout laboratory)					
179A	Thermocouples	8	6	6	3	2	
		(Distribution throughout laboratory)					
180A	Trace Gas Concentrator	18	8	8	1	1	
		(Distribution throughout laboratory)					
182I	Space Vacuum Xtraveh Tube	1	1	1	1	1	
011	Anlzr. Genl, Spectrpho	1	1	1	1	-	

Figure I-5. Equipment Unit EU 005 Biochemical and Biophysics Analysis Unit (Sheet 3)

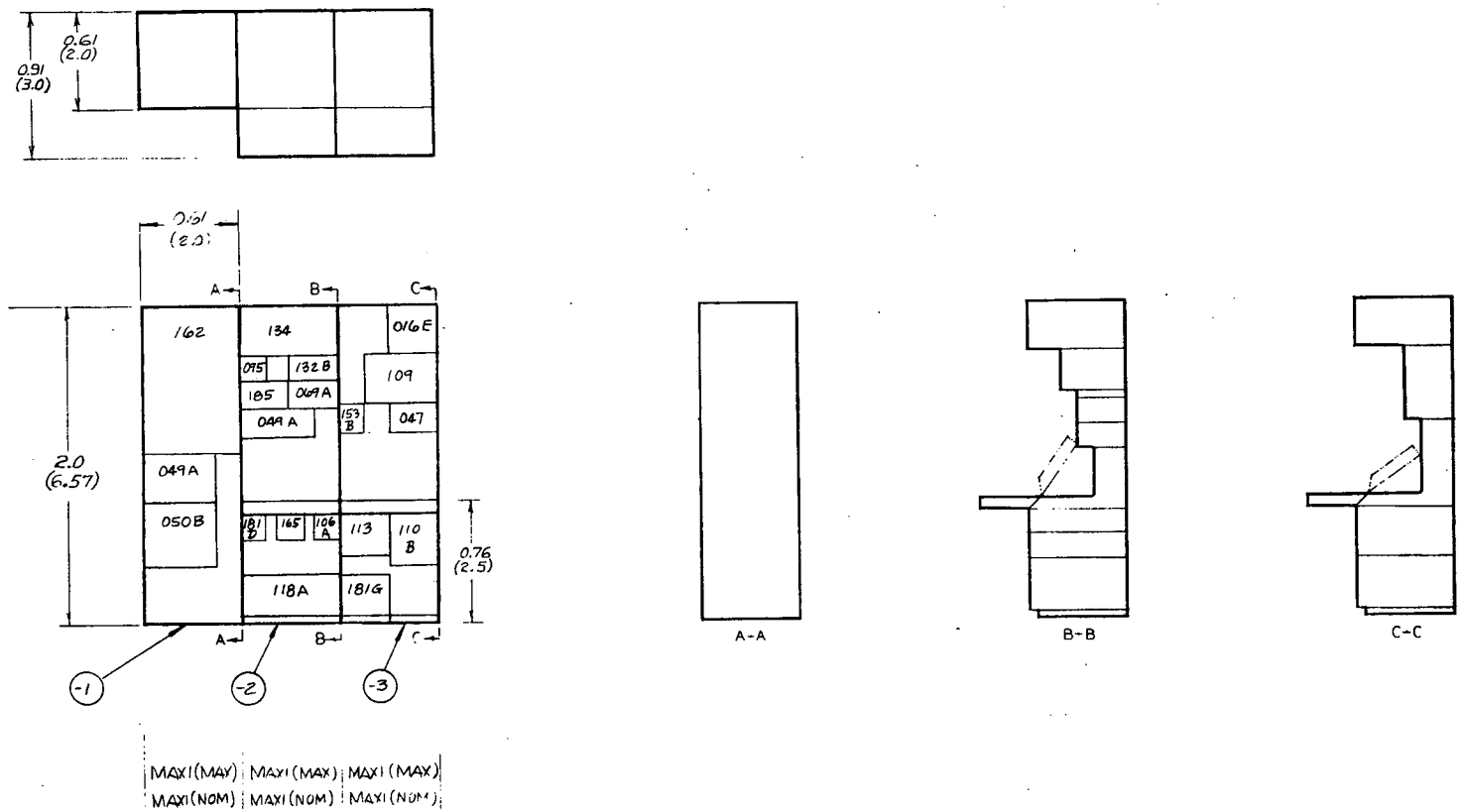


Figure I-6. Equipment Unit EU 006 Maintenance Repair and Fabrication Unit (Sheet 1)

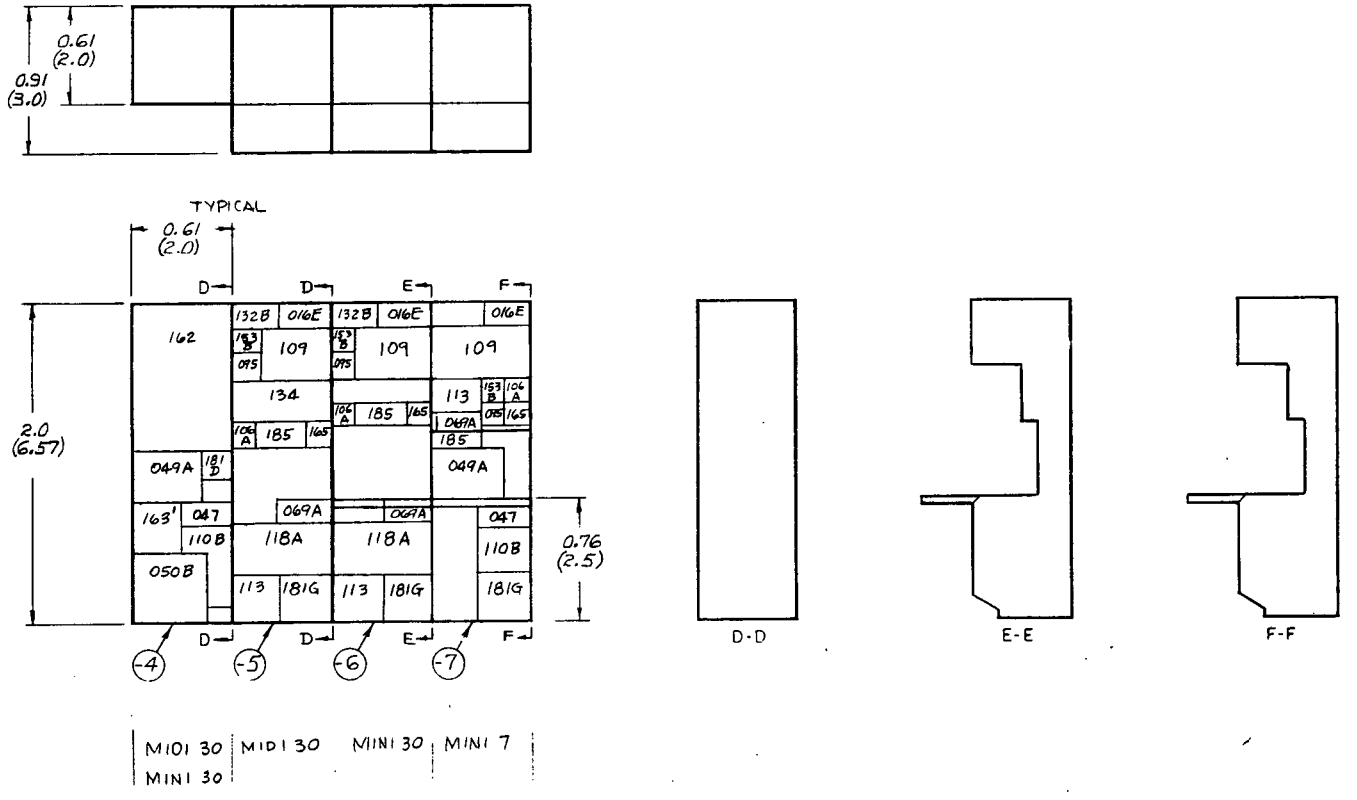


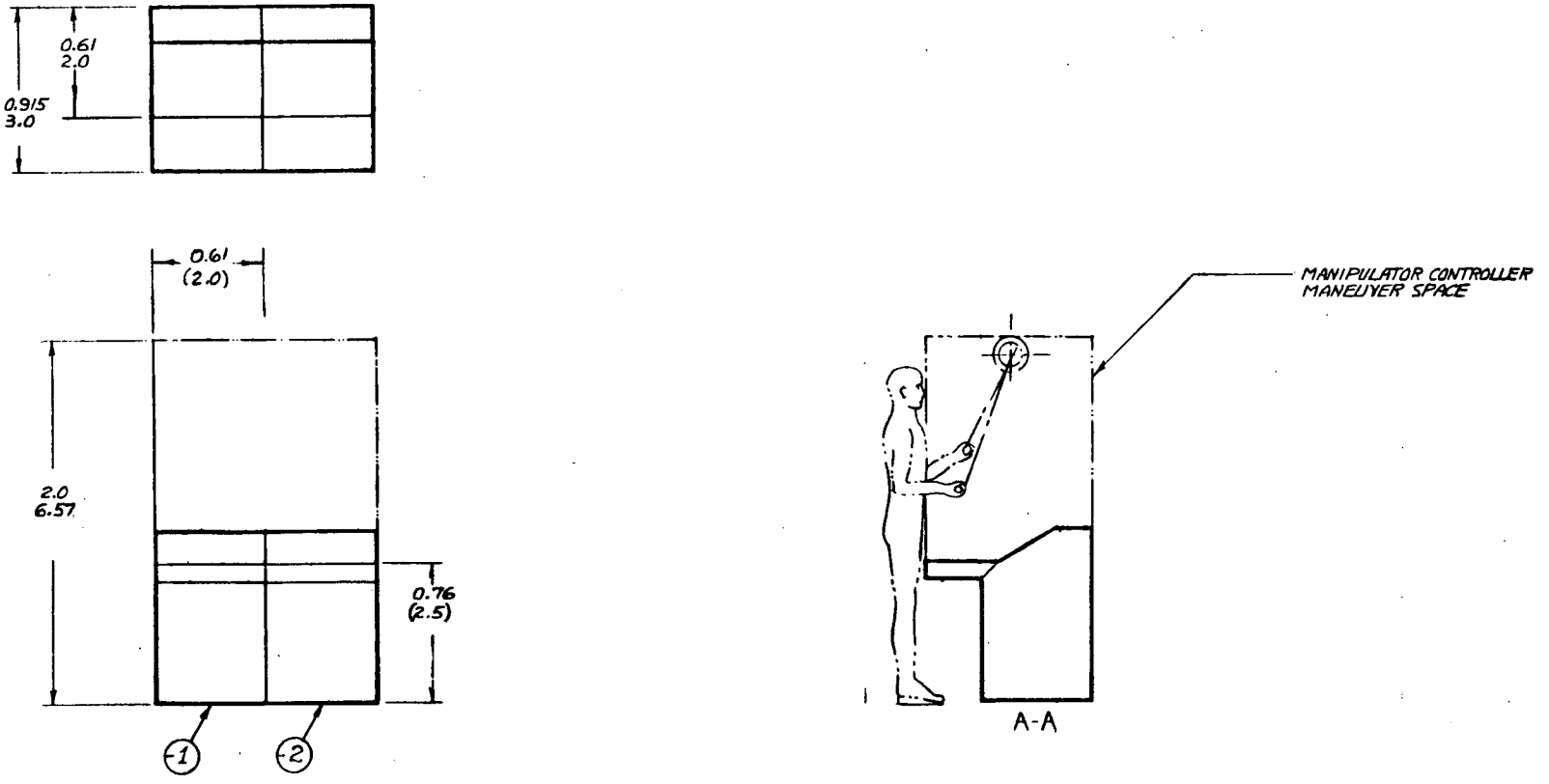
Figure I-6. Equipment Unit EU 006 Maintenance Repair and Fabrication Unit (Sheet 2)

EI NO.	NAME	MAXI MAX	MAXI NOM	MIDI 30	MINI 30	MINI 7	REMARKS
016E	Bags-Plastic, Permeabl	2000	500	500	125	60	
047	Cleanr, Ultrsnc	1	1	1	1	1	
049	Cleanr, Instrmnt/Appar	1	1	1	1	1	
049A	Cleanr, Hand, Steril	1	1	1	1	1	
050B	Compactor (Solids)	1	1	1	1	-	
069A	Electometer	1	1	1	1	1	
076F	Flowmeter, Water Manfld	26	16	8	4	4	
		(Distribution throughout laboratory)					
095	Genrtr, Signl (.01-20K)	1	1	1	1	1	
106A	Kit, Clean-Up	4	2	2	1	1	
109	Kit, Linear Meas	1	1	1	1	1	
110B	Kit Org Hldg/Mgmt	1	1	1	1	1	
113	Kit, Tool, Genl	1	1	1	1	1	
118A	Manifld Flush Sy, Hld	1	1	1	1	-	
132B	Oven, Vacuum 40-80	1	1	1	1	-	
134	Oven, Drying	1	1	-	-	-	
138A	Photocells	200	134	50	12	6	
		(Distribution throughout laboratory)					
138B	Phototransistor (Cplr)	400	134	50	12	6	
		(Distribution throughout laboratory)					
153B	Sensors, Assorted	24	6	6	4	4	
162	Sterilzr, Autoclv, Stm	1	1	1	1	1	
165	Sterlzr, Tool	1	1	1	1	1	
168A	Tags, Io, Organizm	1128	288	288	32	16	
181D	Transducer, Pressure	90	35	35	9	-	
181G	Trash Can	6	4	4	1	1	
		(Distributed throughout laboratory)					
185	Voltmtr (VOM)	3	2	2	1	1	

Figure I-6. Equipment Unit EU 006 Maintenance Repair and Fabrication Unit (Sheet 2)

EI NO.	NAME	MAXI MAX	MAXI NOM	MIDI 30	MINI 30	MINI 7	REMARKS
045	Chem. Storage Cabinet	1	1	1	1	1	
167B	Storage, General	81	47	40	10	6	
167C	Storage, Film	1	1	1	1	1	

Figure I-7. Equipment Unit EU 997, Ancillary Storage

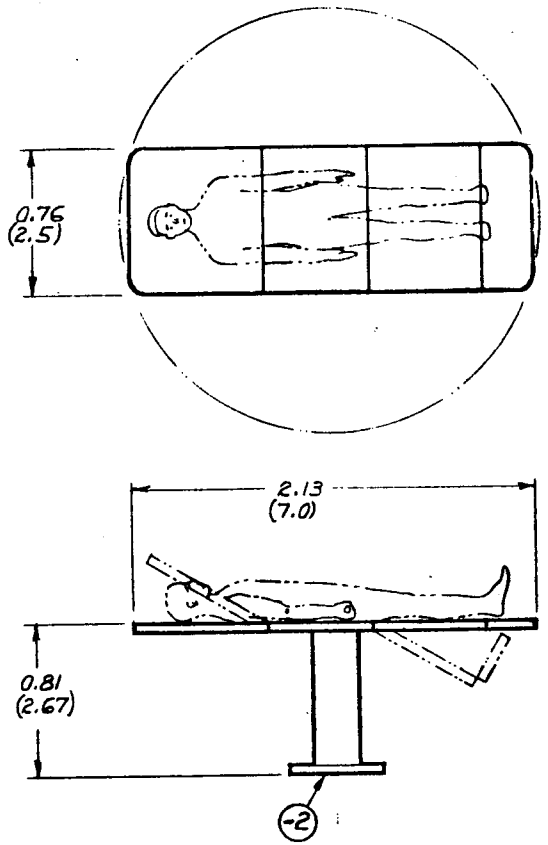


MAXI (MAX)
MAXI (NOM)
MIDI 30
MINI 30
MINI 7

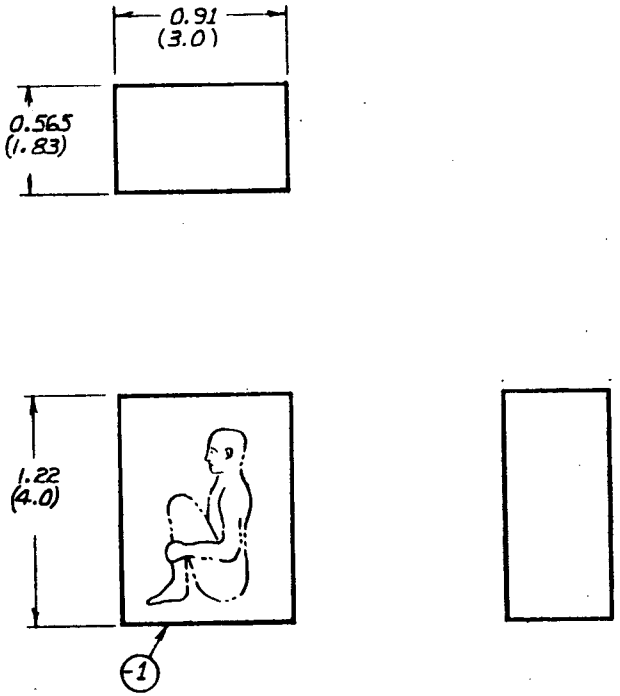
Figure I-8. Equipment Unit EU 011 Remote Manipulator (Part of EU-011 Airlock/EUA Capability (Sheet 1)

EI NO.	NAME	MAXI MAX	MAXI NOM	MIDI 30	MINI 30	MINI 7	REMARKS
003B	Air Lock, Eva	1	1	1	1	1	
		(Part of space station)					
119	Maintenance Task Simu	1	1	1	1	1	
		(Exterior to laboratory)					
119A	Manipulator, Remote	1	1	1	1	1	
143H	Pressure Suit Connectr	6	6	1	1	1	
143I	Pressure Suit Manipu-	1	1	1	1	1	
172	Space Suit + 50 Ft Umbilical	12	4	4	4	4	
		(Stored in Space Station)					
		(Experimental Suit Provisions Stored in EU 080-1 & -2 Consoles) (6 Ft^3)					
158	Space Suit Supply Control	1	1	1	1	1	

Figure I-8. Equipment Unit EU 011 Remote Manipulator (Part of EU-011 Airlock/EUA Capability (Sheet 2)



ROTATING LITTER CHAIR



BODY MASS MEASUREMENT UNIT

MAXI (MAX)
MAXI (NOM)
MIDI 30
MINI 30

Figure I-9. Equipment Unit EU 012 Rotating Litter Chair and Body Mass Measurements (Sheet 1)

EI NO.	NAME	MAXI MAX	MAXI NOM	MIDI 30	MINI 30	MINI 7	REMARKS
019D	Body Mass Measurement	1	1	1	1	-	
153A	Rotating Litter Chair	1	1	1	1	-	

Figure I-9. Equipment Unit EU 012 Rotating Litter Chair and Body Mass Measurements (Sheet 2)

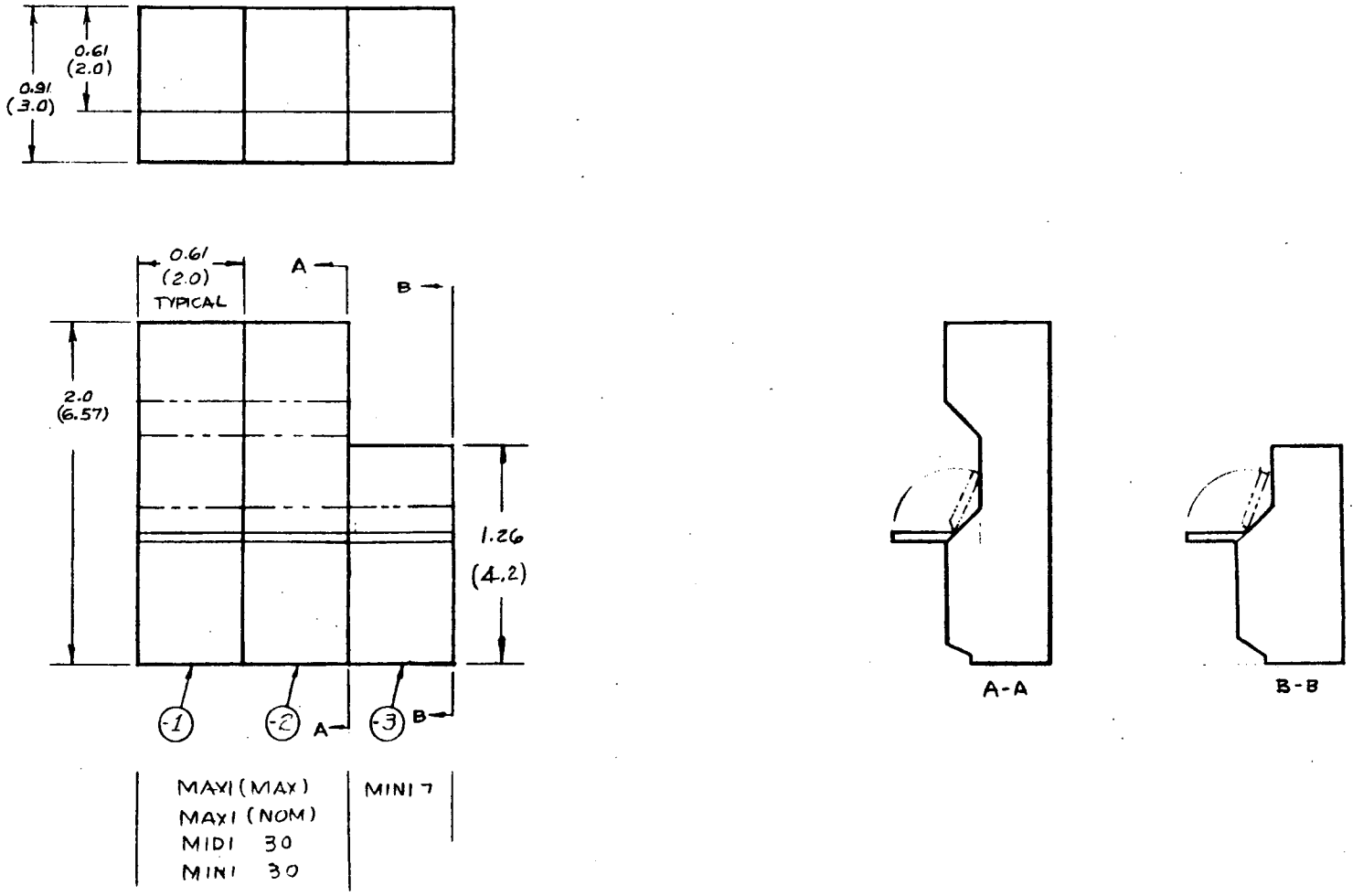


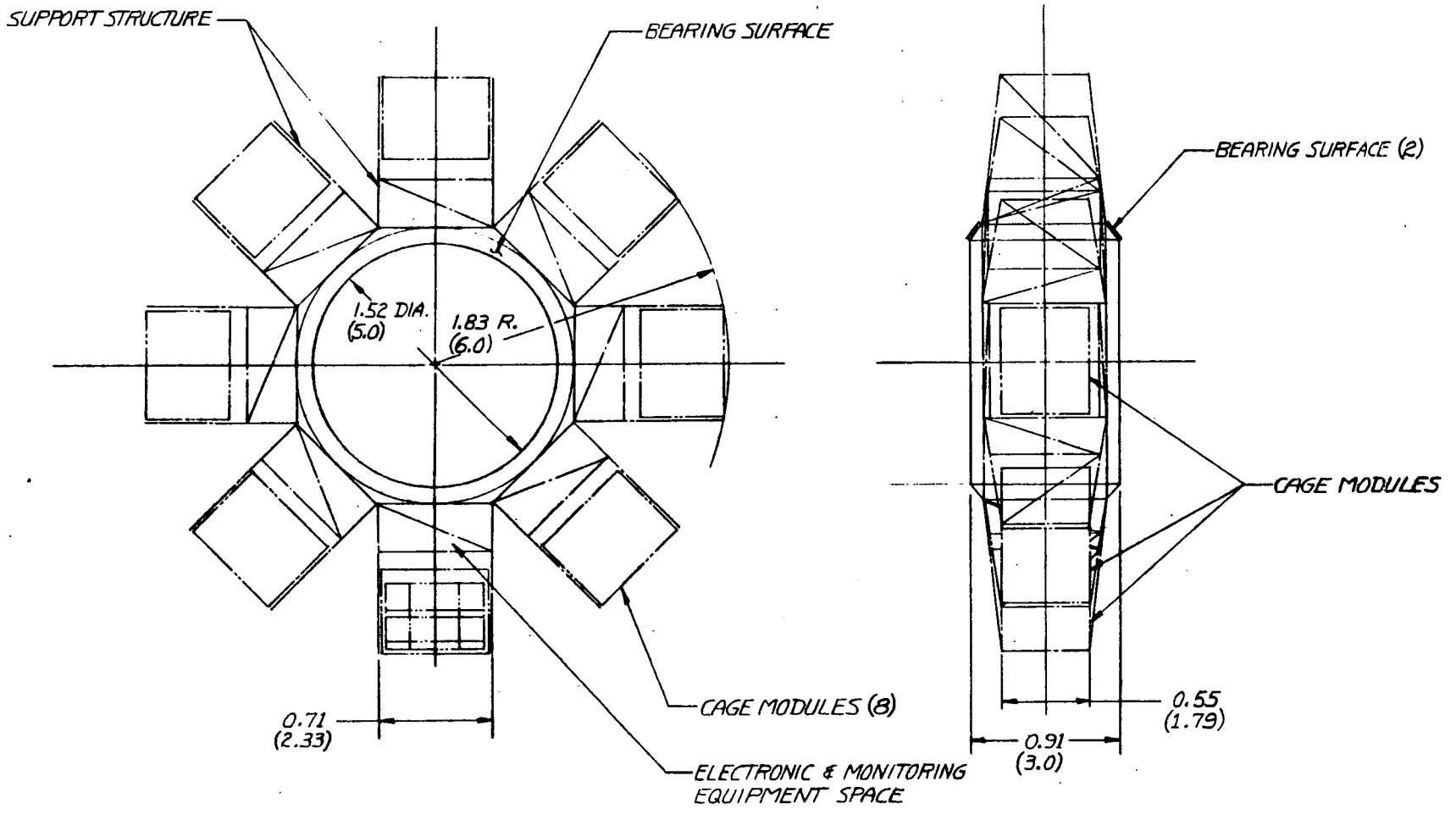
Figure I-10. Equipment Unit EU 012/031 Bio-Medical Man-System Integration Research Support Unit (Sheet 1)

EI NO.	NAME	MAXI MAX	MAXI NOM	MIDI 30	MINI 30	MINI 7	REMARKS
018D	Custom Bite Boards	12	6	6	3	-	
065B	Electrophysiology Monitor	1	1	1	1	1	
065C	Electrophysiology Receiver	1	1	1	1	1	
065D	Electrophysiology Display	2	1	1	1	1	
065E	Electrophysiology Monitor	1	1	1	1	-	
131E	Non-Visual Dirctn Indicator	1	1	1	1	-	
133	Otolith Test Goggle	1	1	1	1	-	
144B	Psychogalvanomtr GSR	2	2	2	2	-	
125E	Metabolic Anal Back Pack	1	1	1	1	1	

Figure I-10. Equipment Unit EU 012/031 Bio-Medical Man-System Integration Research Support (Sheet 2)

EI NO.	NAME	MAXI MAX	MAXI NOM	MIDI 30	MINI 30	MINI 7	REMARKS
FROM	EU-30						
016F	Coupler Ballistocardiogram	1	1	1	1	-	
104E	Coupler Impedance Carigrm	4	4	4	2	-	
104F	Impedance Pheumograph	1	1	1	1	-	
140	Coupler Phono/Vibrocardgrm	4	2	2	1	-	
EU031	Reference						
036	Camera-Iris 35MM Special	1	1	1	1	-	
076K	Flowmeter, Doppler	2	2	2	2	-	
110C	Kit Physiology	1	1	1	1	-	
125D	Metabolic Analyzer Fixed	1	1	1	1	-	
139	Plethysmograph, Limb	2	2	2	1	-	
139A	Pneumotachograph	1	1	1	1	-	
182J	Coupler, Vectorcardiogram	2	2	2	1	-	
186A	Vomitus Bags and Holders	18	7	7	4	-	

Figure I-10. Equipment Unit EU 012/031 Bio-Medical Man-System Integration Research Support (Sheet 3)



MAXI (NOM)
MIDI 30

Figure I-11. Equipment Unit EU 021/023 Internal Centrifuge (Sheet 1)

EI NO.	NAME	MAXI MAX	MAXI NOM	MIDI 30	MINI 30	MINI 7	REMARKS
042D	Centrifuge Slip Ring Assy	-	1	1	-	-	
043D	Centrifuge-Speciman	-	1	1	-	-	

Figure I-11. Equipment Unit EU 021/023 Internal Centrifuge (Sheet 2)

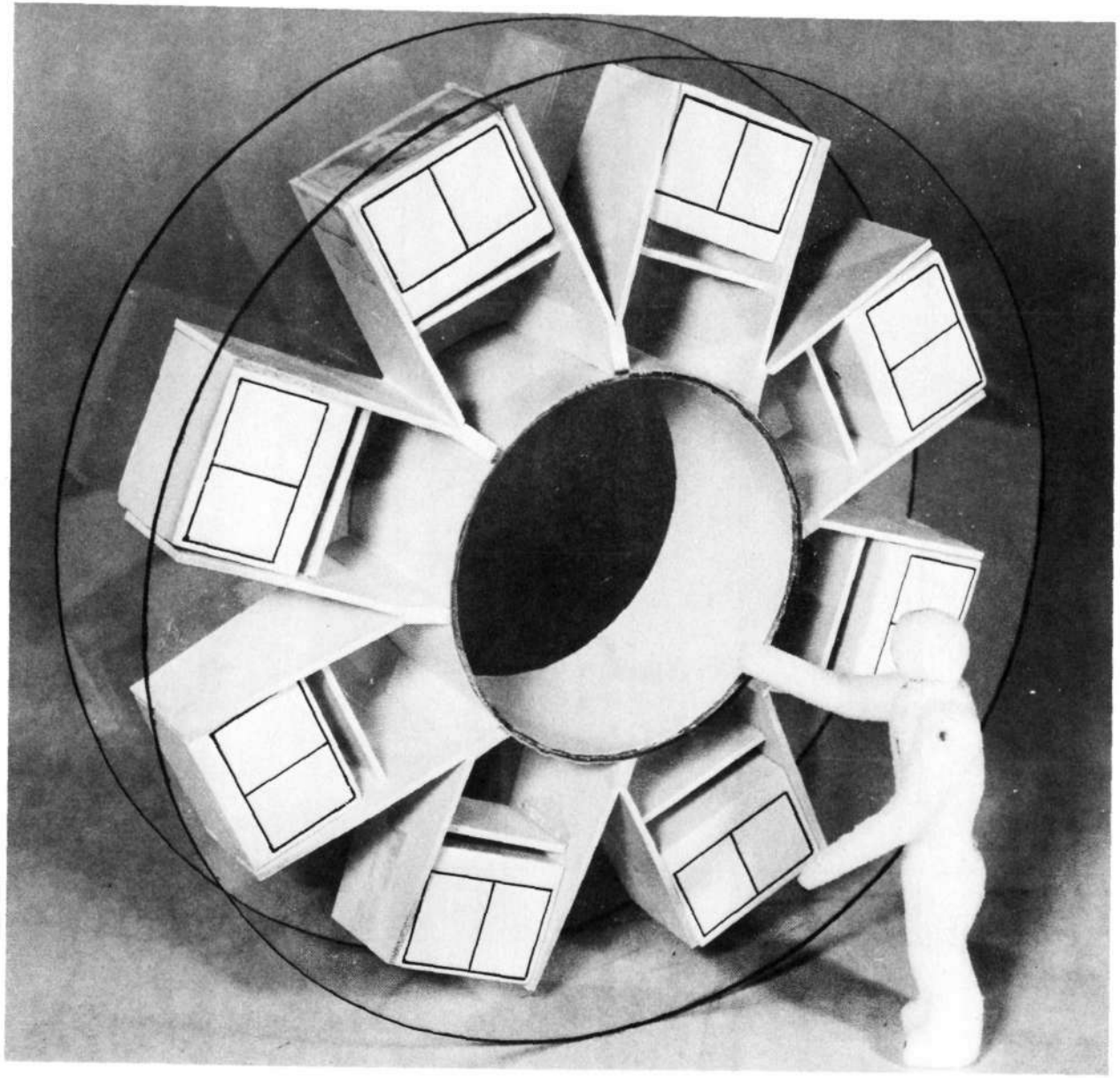


Figure I-12. Internal Bio-Research Centrifuge (Sheet 1)

EI NO.	NAME	MAXI MAX	MAXI NOM	MIDI 30	MINI 30	MINI 7	REMARKS
042F	Centrifuge, Common Use RC	1	-	-	-	-	

Figure I-12. Internal Bio-Research Centrifuge (Sheet 2)

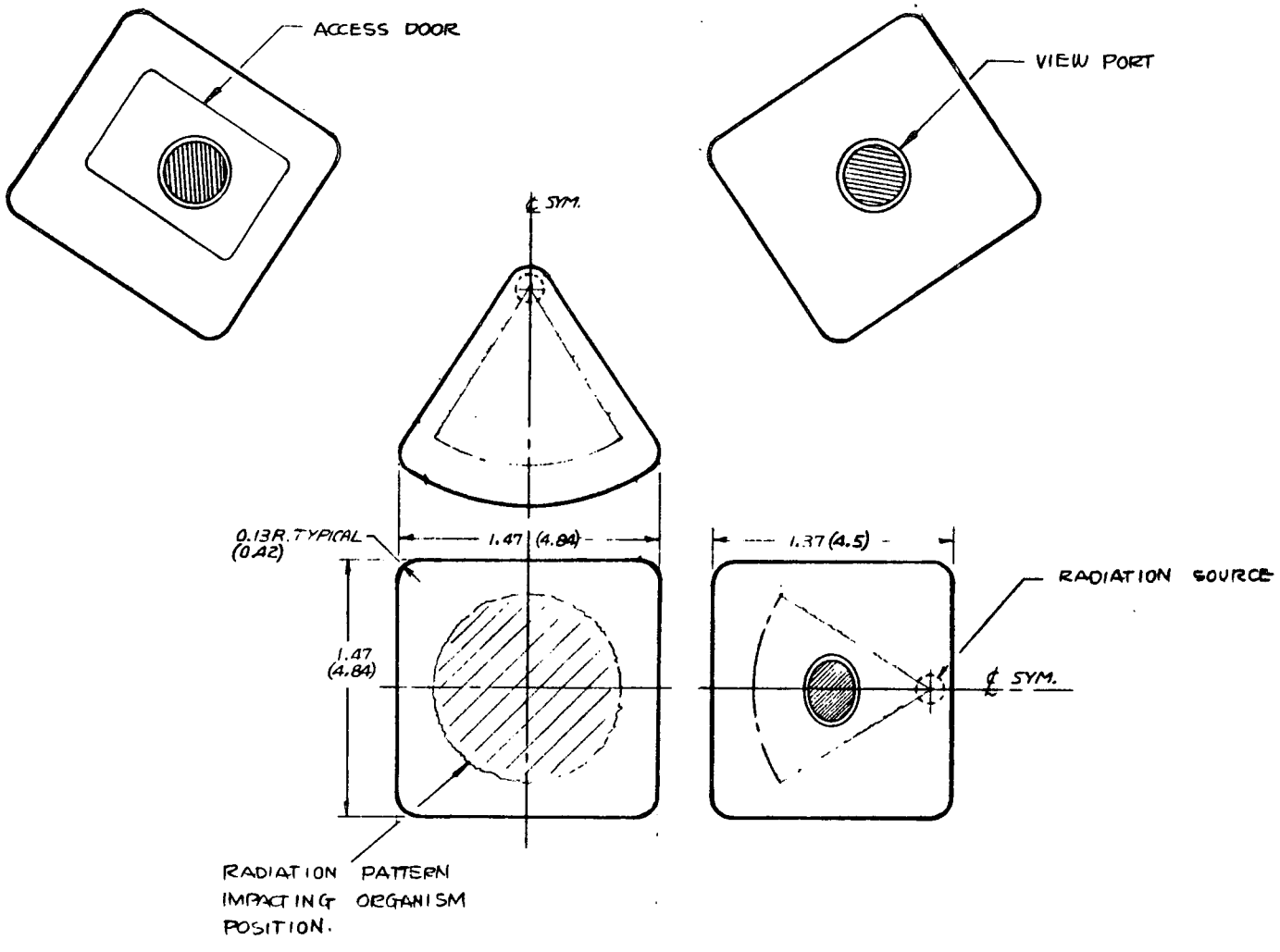
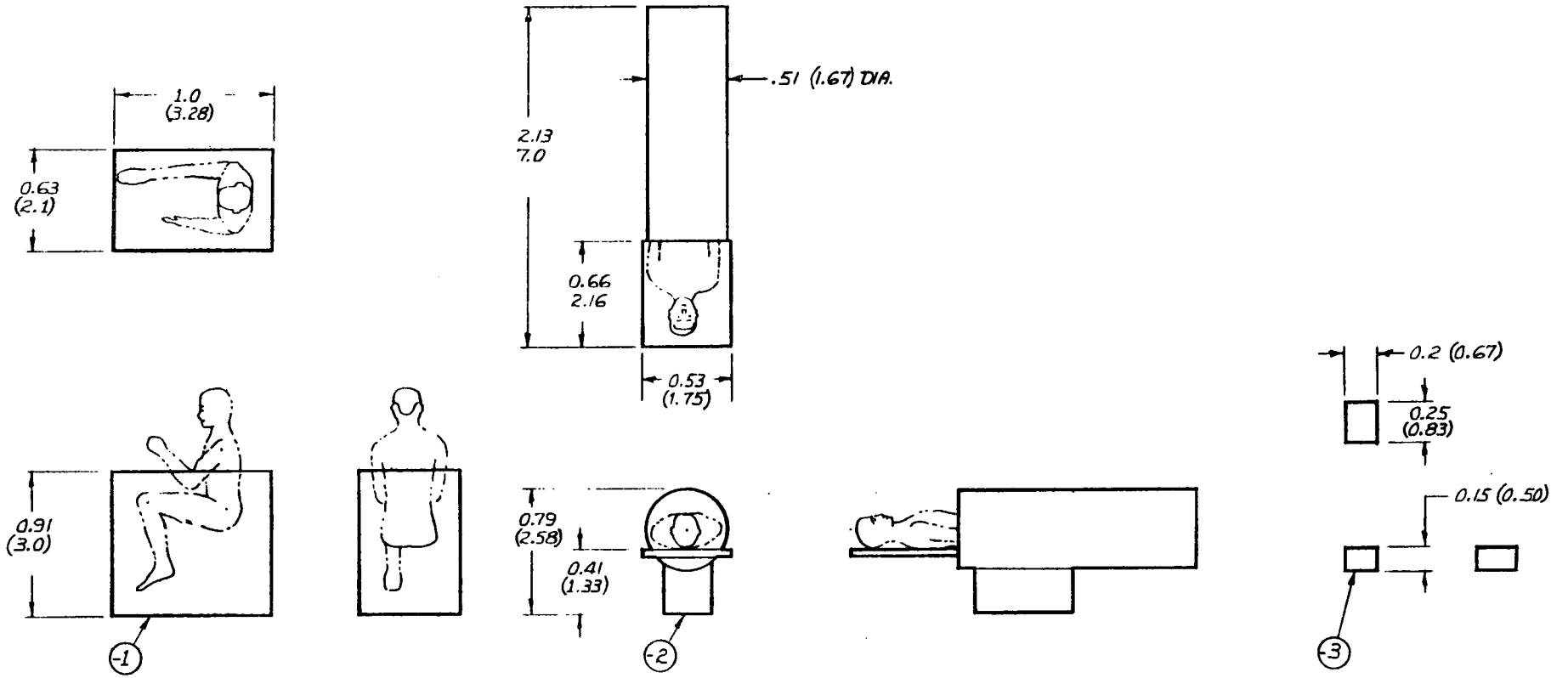


Figure I-13. Equipment Unit EU 025/026 Radiation Exposure Unit (Sheet 1)

EI NO.	NAME	MAXI MAX	MAXI NOM	MIDI 30	MINI 30	MINI 7	REMARKS
EU025	Reference						
016D	Badges-Rad, Std Film	532	152	152	52	36	
051C	Control Panl, Shield	1	-	-	-	-	
062A	Developer, Film	1	1	1	1	-	
144C	Radiatn Detctr, Dosmtr	4	4	4	1	1	
145	Radiatn Detectr, General	6	4	4	2	1	
147B	Radiatn, Room	1	-	-	-	-	
150	Radiatn, Source Stor	2	1	1	1	1	
EU026	Reference						
076D	Film Table, X-rays	1	-	-	-	-	
147C	Radiatn Room Rack Sys	1	-	-	-	-	
149F	Radiatn Srce, Isotope	1	-	-	-	-	
149G	Radiatn Source, Prepkgd	1	1	1	1	-	
149H	Radiation Whole Body Scan	1	1	1	1	-	

Figure I-13. Equipment Unit EU 025/026 Radiation Exposure Unit (Sheet 2)

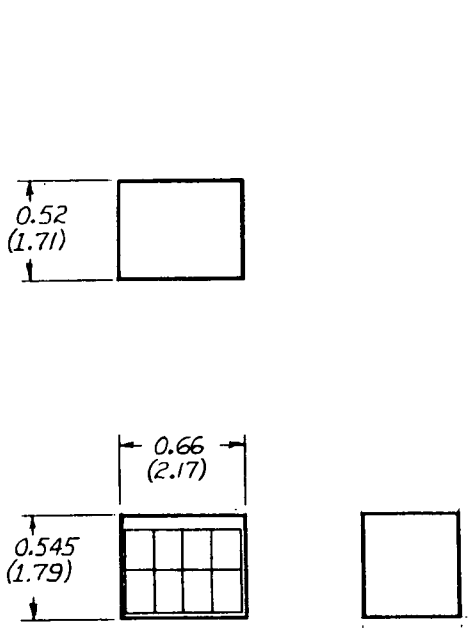


MAXI (MAX)
MAXI (NOM)
MIDI 30
MINI 30

Figure I-14. Equipment Unit EU 030 Bicycle Ergometer, Lower Body Negative Pressure, Exergenie (Sheet 1)

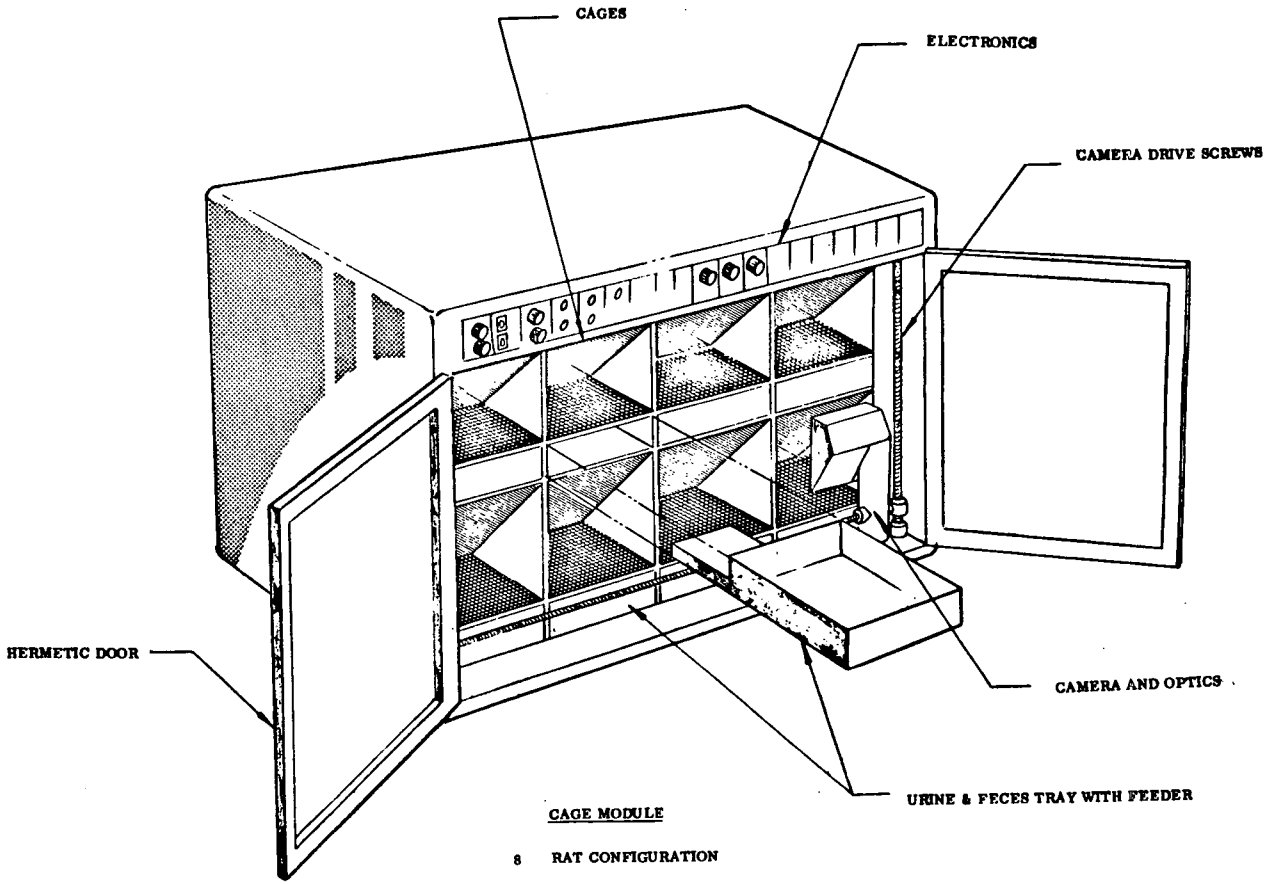
EI NO.	NAME	MAXI MAX	MAXI NOM	MIDI 30	MINI 30	MINI 7	REMARKS
016F	Coupler, Ballistocardiogram Included in EU-012/031						
104E	Coupler, Impedance Cardiogram Included in EU 012/031						
104F	Impedance Pneumograph Included in EU 012/031						
140	Coupler Phono/Vibrocardgrm Included in EU012/031						
018C	Bicycle Ergometer	1	1	1	1	-	
117	Lower Body Negative Pressure	1	1	1	1	-	
-	Exergenie	1	1	1	1	-	

Figure I-14. Equipment Unit EU 030 Bicycle Ergometer, Lower Body Negative Pressure, Exergenie (Sheet 1)



1/20 SCALE REDUCED

MAXI (MAX)
MAXI (NOM)
MIDI 30
MINI 7



CAGE MODULE

8 RAT CONFIGURATION

Figure I-15. Equipment Unit EU 040-050-060-070 Cage Module (Sheet 1)

EI NO.	NAME	MAXI MAX	MAXI NOM	MIDI 30	MINI 30	MINI 7	REMARKS
-	Cage Module	48					In Zero g lab
		50					In R.C.
			20				In Zero g lb
			8				In Internal Cent
				20			In Zero g lab
				8			In Internal Cent.
					6	4	
	Note: Cages, feces management system, feeding and watering systems, and urine collector systems are provided in above cages and cage modules as required.						

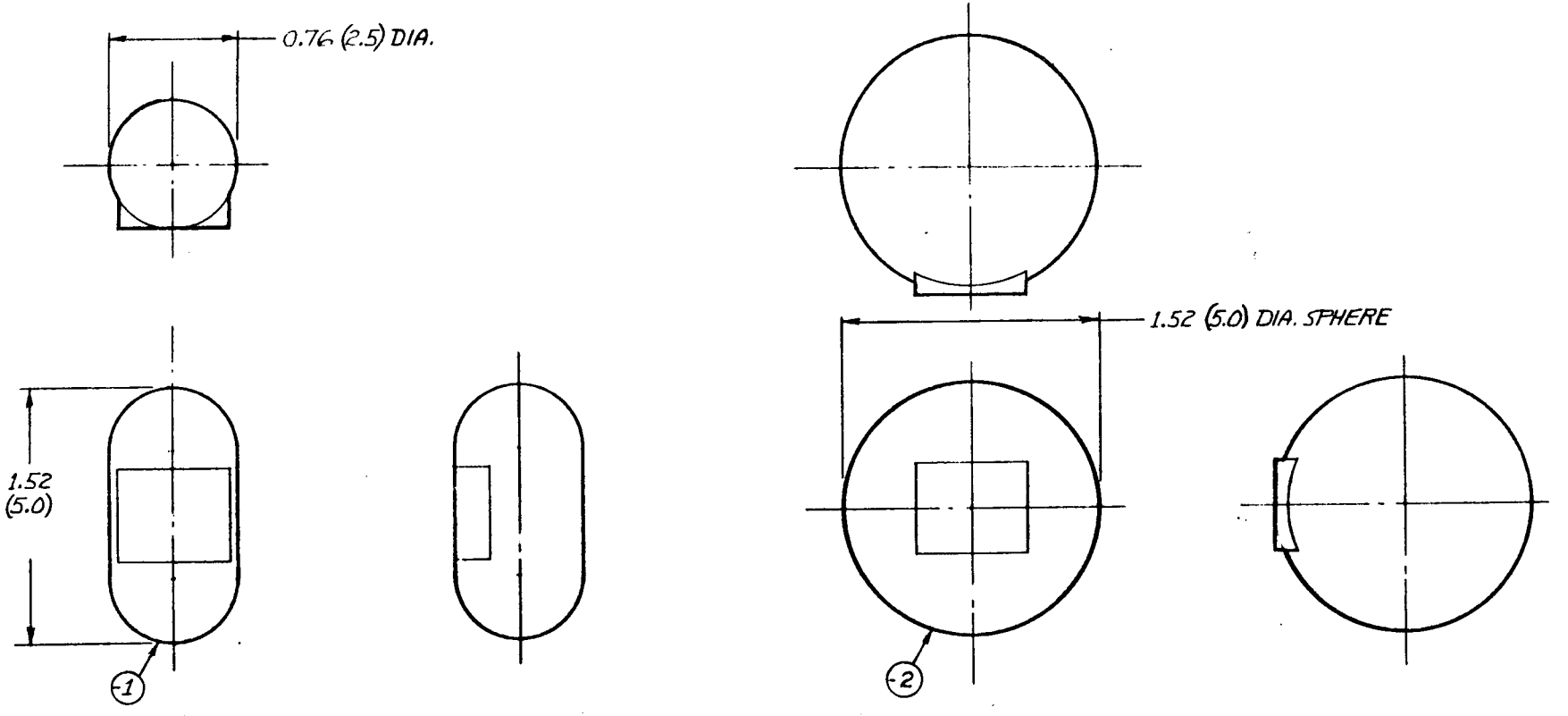
Figure I-15. Equipment Unit EU 040-050-060-070 Cage Module (Sheet 2)

EI NO.	NAME	MAXI MAX	MAXI NOM	MIDI 30	MINI 30	MINI 7	REMARKS
EU 040	Ref. Small Vertebrate Holding Unit						
022	Cage, Colony, RAT	8	2	2	1	-	
023	Cage, Colony, Rabbit	8	2	2	1	-	
026	Cage, Launch/Reentry	256	128	128	16	-	
027	Cage, MMB, Rabbit	8	4	4	1	-	
028	Cage, MMB, RAT	34	8	8	2	-	
030	Cage, RAB/MAR/G PG/CHK	66	8	8	2	-	
030A	Cage, RAT/HAMP/Quail	262	128	128	16	-	
072C	Feces Vacuum System-Cage	7	-	-	-	-	
074	Feeder, Pel Dispnsr	259	128	128	16	-	
074B	Feeder Paste	131	32	-	-	-	
103	Holding Unit, Small Verts	64	16	16	2	-	
118D	Manifold, Organism, Water	1	1	1	1	-	
182A	Urine Collector System	1	1	1	-	-	
182G	Urine Pads	2500	2000	512	-	-	
EU 050	Ref. Plant Holding Unit						
026B	Cage MMB, Plant	32	16	16	2	1	
029	Cage, Plnt, Pot	8	4	4	1	1	
101	Hldg Unit, Plant	18	8	8	2	1	

Figure I-15. Equipment Unit EU 040-050-060-070 Cage Module (Sheet 3)

EI NO.	NAME	MAXI MAX	MAXI NOM	MIDI 30	MINI 30	MINI 7	REMARKS
EU 060	Ref. Cell and Tissue Holding Unit						
025B	Colony Chmbr, Sealbl, CT	4	4	4	2	2	
026A	Cage MMB, C/T	16	8	-	-	-	
098A	HLDG Unit INCBTR - Cells	8	2	2	2	2	
098B	HLDG Unit INCBTR - Cells	1	1	1	-	-	
EU 070	Ref. Invertebrate Holding Unit						
025	Cage, Inverts, (Jars)	8	4	4	1	1	
025A	Colony Chmbr, Sealbl, IV	4	4	4	2	2	
098C	HLDG Unit INCBTR - Inverts	6	2	2	1	1	

Figure I-15. Equipment Unit EU 040-050-060-070 Cage Module (Sheet 4)



MACAQUE CYLINDER

PRIMATE SPHERE

MAXI (MAX) (2)
MAXI (NOM) (2)
MIDI 30 (2)
MINI 30 (2)
MINI 7 PERTURBATION (2)

MAXI (MAX)

Figure I-16. Equipment Unit EU 041 Primate Holding Facility (Sheet 1)

EI NO.	NAME	MAXI MAX	MAXI NOM	MIDI 30	MINI 30	MINI 7	REMARKS
028A	Cage, Monk, MACAC	4	4	2	1	-	
029A	Cage, Primate Sphere	2	-	-	-	-	
100	HLDG Unit MMP Prmate	2	2	2	1	-	
156E	Signal Cond Rack	104	28	28	4	-	

Figure I-16. Equipment Unit EU 041 Primate Holding Facility (Sheet 2)

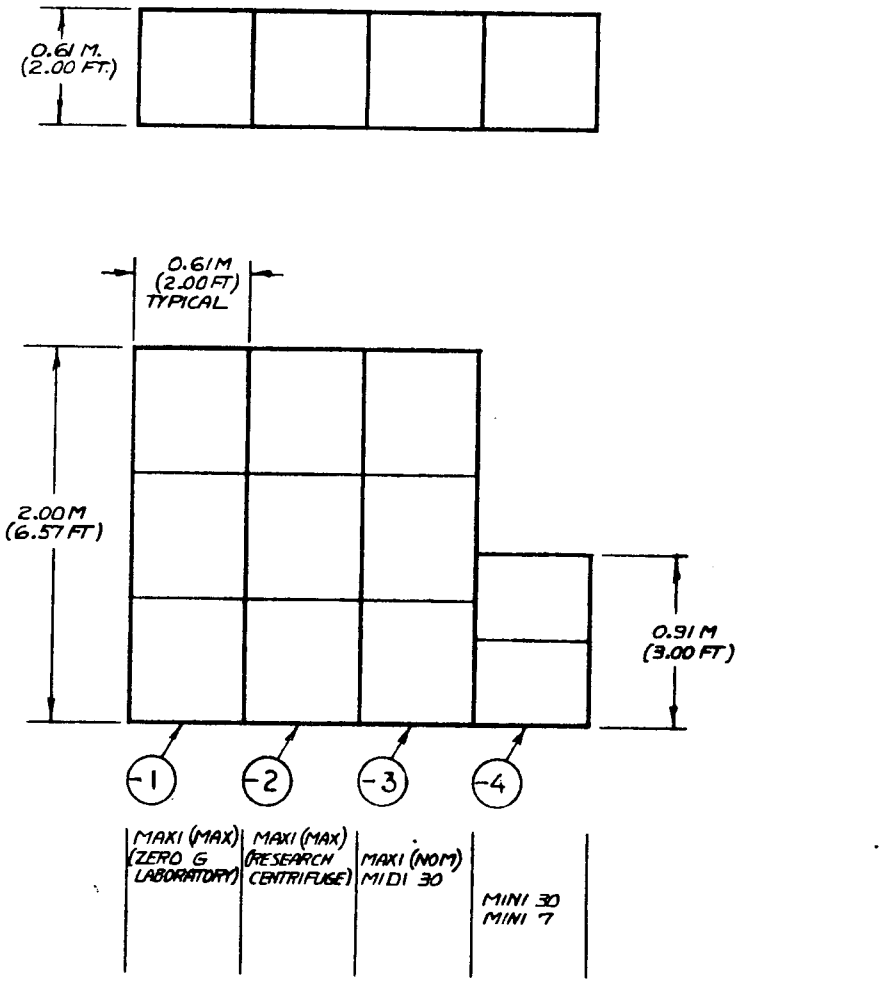


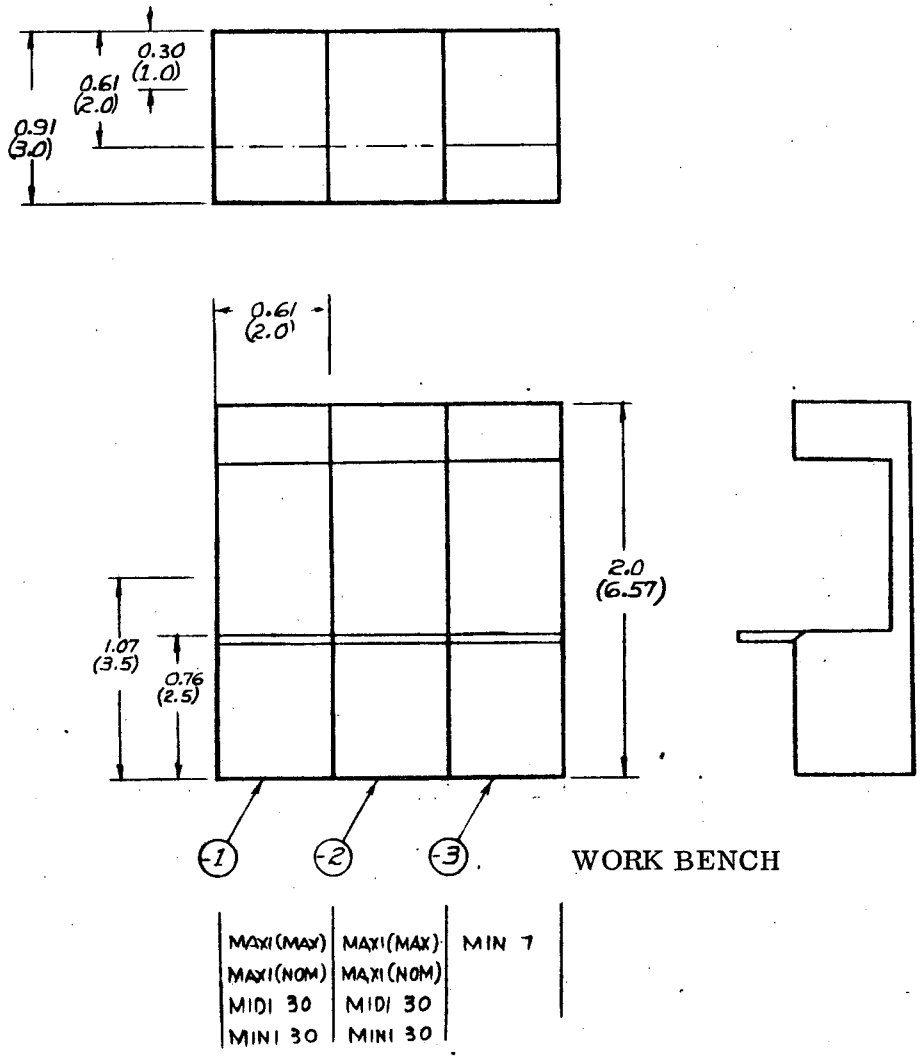
Figure I-17. Equipment Unit EU-042/071 Holding Unit Support (Sheet 1)

EI NO.	NAME	MAXI MAX	MAXI NOM	MIDI 30	MINI 30	MINI 7	REMARKS
Ref	EU 042 Vertebrate Research Support Unit						
014A	Animal Maze, RAT	1	1	1	-	-	
016A	Audio-Vis Tactl Stim	1	1	1	-	-	
016C	Behavior Unit, Prim	2	2	2	-	-	
019A	Biobackpack, Micro	16	8	-	-	-	
024	Cage Insrt, Mice	16	6	6	1	-	
063F	Dividers, Rabbit Cage	8	4	2	2	-	
071	Exrcisr/Ergomtr (Prim)	2	1	1	-	-	
072	Exrcisr, RAT	8	4	2	-	-	
072B	Feces Storage Sys (Part of ECS)	8	2	2	-	-	
073	Feedr, Liq, Auto	128	32	32	8	8	
076G	Flowmeter, Ultrasonic	2	2	2	2	-	
112	Kit, Medical Surgical	1	1	1	1	-	
115	Kit, Veternry	1	1	1	1	1	
115A	Lgt Discrim Apprtus	1	1	1	-	-	
132A	Oscillator VCO	70	18	18	3	-	
143E	Pressurecuff W/XDCR	2	2	1	1	-	
143F	Pressurecuff Pump	2	2	1	1	-	
150B	Receiver-Exg, Cage Mod	32	16	-	-	-	
154A	Restraint Chair-Primte	2	2	2	-	-	
155A	Sensor, Implntd	102	28	28	12	-	
170	Strain Gage, Mus Skel	1	1	-	-	-	
177	T Sens, Body	95	75	64	32	8	
181A	Xdcr Blood Flow	12	12	-	-	-	
181B	Transducer-Plythesmgph	22	10	10	6	6	
181C	Xdcr Blood Pressure	22	10	10	6	-	
183A	Visual Cliff	1	1	1	-	-	

Figure I-17. Equipment Unit EU-042/071 Holding Unit Support (Sheet 2)

EI NO.	NAME	MAXI MAX	MAXI NOM	MIDI 30	MINI 30	MINI 7	REMARKS
Ref	EU 051 Plant Research Support Unit						
030B	Cage Shelf, Plnt Seedl	8	4	4	1	1	
050	Clinostat	1	1	1	1	1	
075	Feedr, Plnt, Auto	192	96	-	-	-	
076	Feedr, Plnt, Manul	64	32	-	-	-	
111	Kit, Plnt Tools	1	1	1	1	1	
113A	Kit, Tool-Insect Manip.	1	1	1	1	1	
125A	Medium Substrate Plant	8	-	-	-	-	
131D	Motor, Plnt Grwth Mntr	32	32	16	4	2	
143C	Pump, Gas Circulatng	16	8	8	2	2	
156B	Squibs, Fixative	16	8	8	8	4	
156C	Squib Firing Apparatus	6	3	3	2	1	
Ref	EU 061 Cell & Tissue Research Support Unit						
006	Air Partcl Smpl Colect	1	1	1	1	1	
019C	Botl C/T Cult Opt Flts	32	8	8	-	-	
123	Media, Dehydrtd	1	1	1	1	1	
124	Media, Prepred	6	4	4	2	1	
125	Media Prep Contnrs	18	8	-	-	-	

Figure I-17. Equipment Unit EU-042/071 Holding Unit Support (Sheet 3)



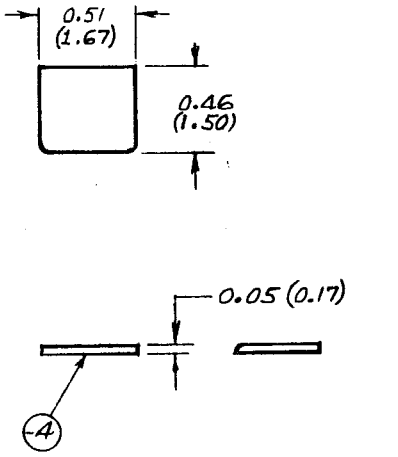


Figure I-18. Equipment Unit EU080/081 Life Support Subsystem Test Unit (Sheet 1)

EI NO.	NAME	MAXI MAX	MAXI NOM	MIDI 30	MINI 30	MINI 7	REMARKS
EU 080	Ref.						
1181	Manifold, Vacuum	2	2	1	1	-	
142	Portable LSS (PLSS)	3	1	1	1	1	
158A	Space Suit Supply Consol	2	2	1	1	1	
182H	Valves, Assorted	20	12	12	6	6	
EU 081	Ref						
115C	Leak Detector	-	-	1	-	-	
155B	Shroud, Environmental	1	1	-	-	-	

Figure I-18. Equipment Unit EU080/081 Life Support Subsystem Test Unit (Sheet 2)

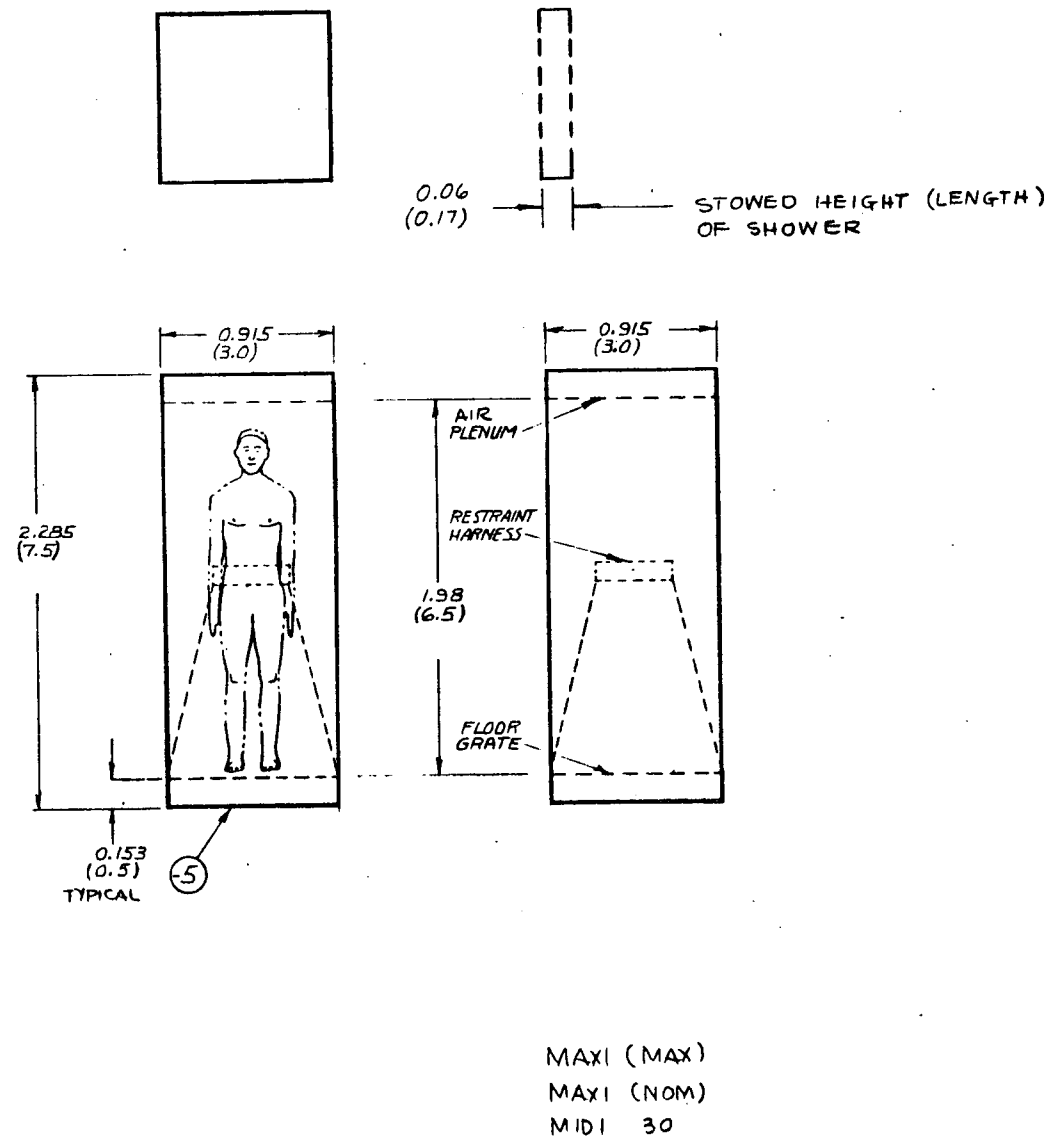


Figure I-19. Equipment Unit EU 080/081 Life Support Subsystem Test Unit (Sheet 1)

EI NO.	NAME	MAXI MAX	MAXI NOM	MIDI 30	MINI 30	MINI 7	REMARKS
--	Whole Body Shower	1	1	1	-	-	

Figure I-19. Equipment Unit EU 080/081 Life Support Subsystem Test Unit (Sheet 2)

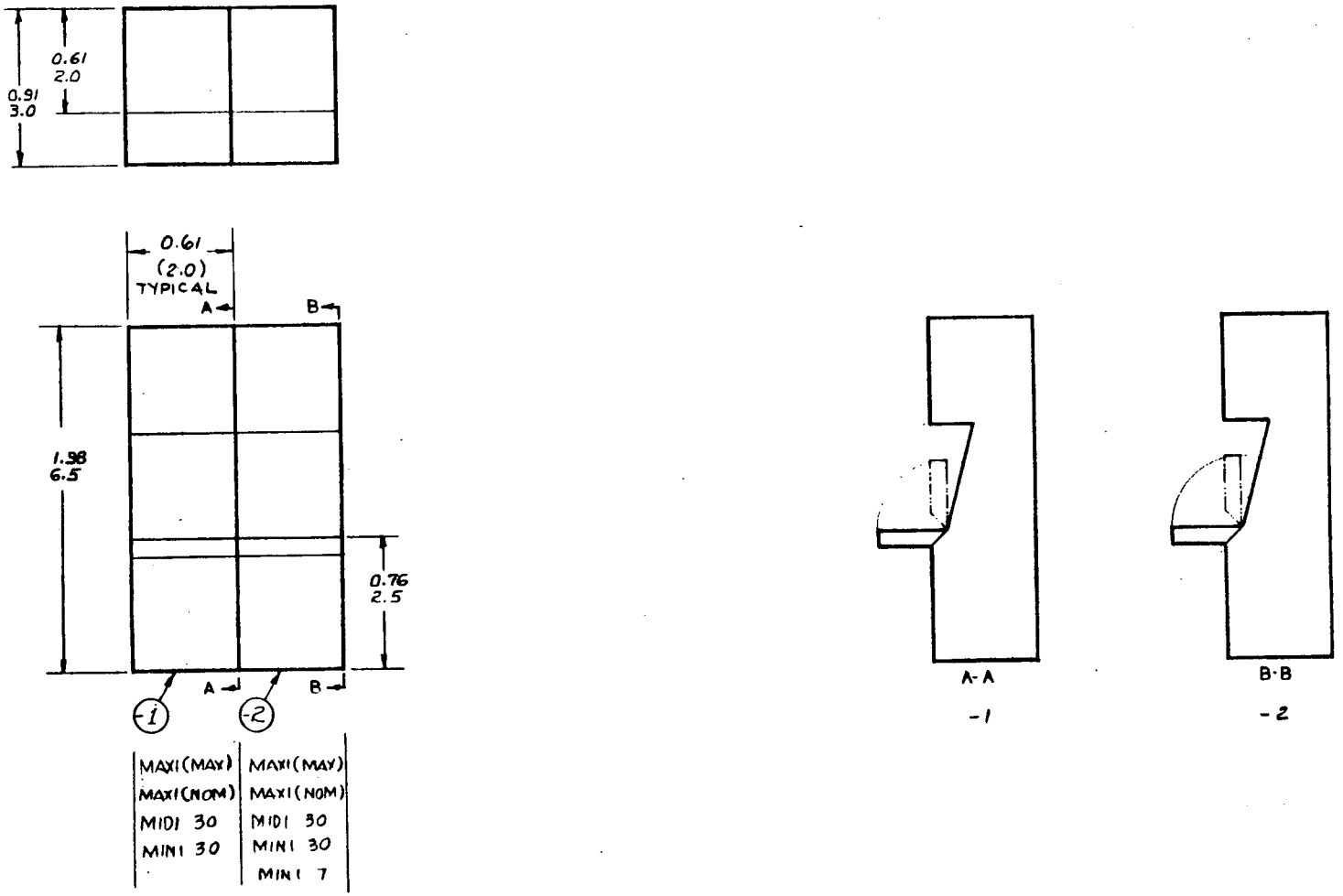


Figure I-20. Equipment Unit EU091 Behavioral Measurements Unit (Sheet 1)

EI NO.	NAME	MAXI MAX	MAXI NOM	MIDI 30	MINI 30	MINI 7	REMARKS
015D	Audio Stereo Headset	2	2	2	1	-	
105A	Kit, Behavioral Msurmts I	2	1	1	-	-	
105B	Kit, Behavioral Msrmts II	2	1	1	-	-	
115D	Limb Board, Mtr or Manl Rotn	2	1	1	-	-	
131H	Optiscan-Field and Fixt	2	1	1	1	1	
144	Psychomtr Perf Panel	1	1	1	1	1	
152A	Room, Private Grnd Communctn	1	1	-	-	-	
176G	Taskboard, Maint/Gross Coord	2	1	1	1	-	
176H	Taskboard, Force/Torque	2	1	1	1	-	
179C	Timer, Integral Equipment	20	20	7	-	-	
		(Distributed thruout Laboratory)					
182K	Vision Testr-	2	1	1	1	-	

Figure I-20. Equipment Unit EU091 Behavioral Measurements Unit (Sheet 2)

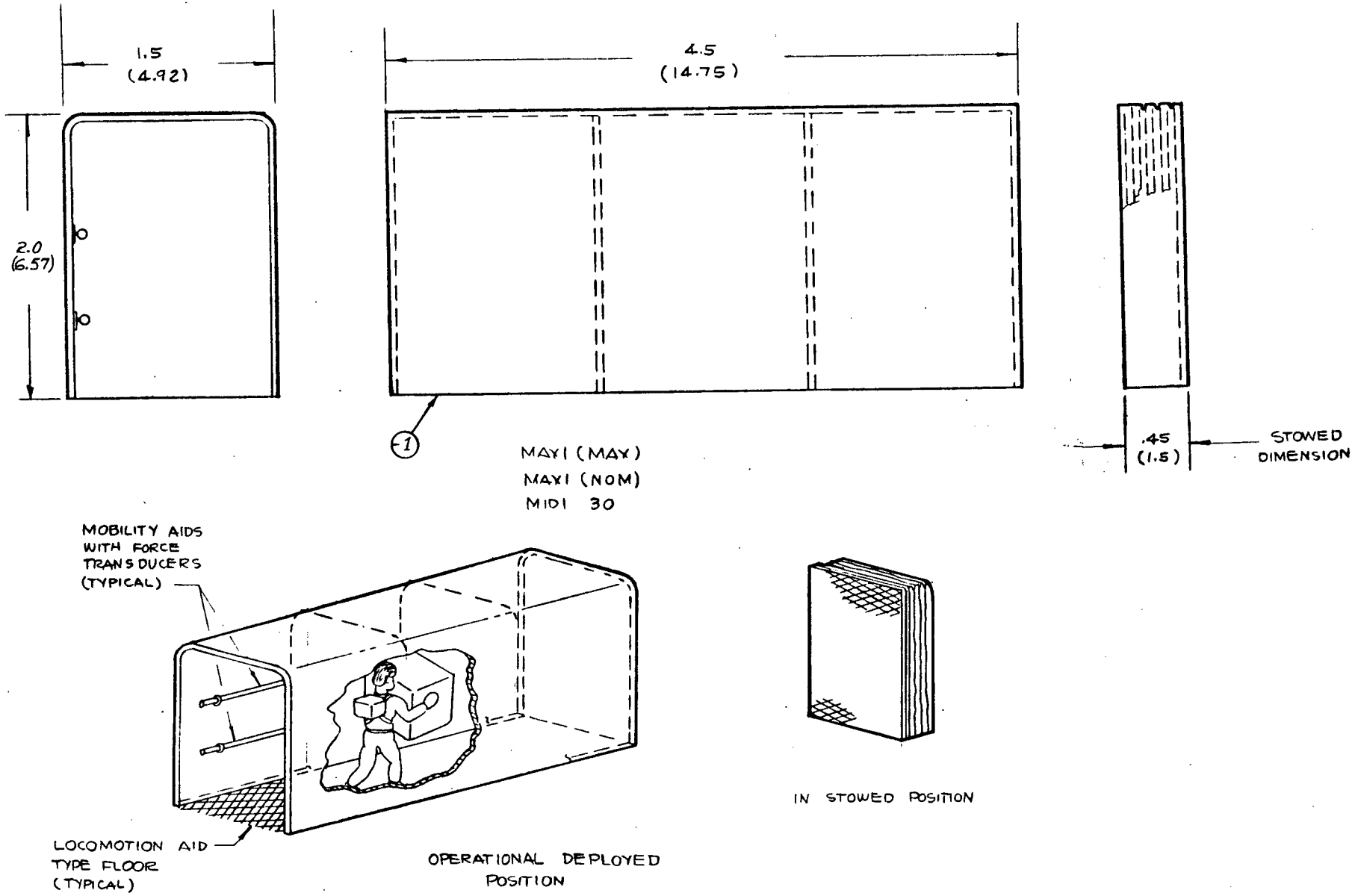


Figure I-21. Equipment Unit EU093 Mobility Unit - Damage Proof (Sheet 1)

EI NO.	NAME	MAXI MAX	MAXI NOM	MIDI 30	MINI 30	MINI 7	REMARKS
015	Anthropometric Grid	7	3	3	1	1	
122A	Mass, Test-Var. Size,Wt, Shap	5	5	5	3	3	
		(Utilize Masses avail. in lab.)					
126I	Mobility Unit-Protct Corrd	1	1	1	-	-	

Figure I-21. Equipment Unit EU093 Mobility Unit - Damage Proof (Sheet 2)

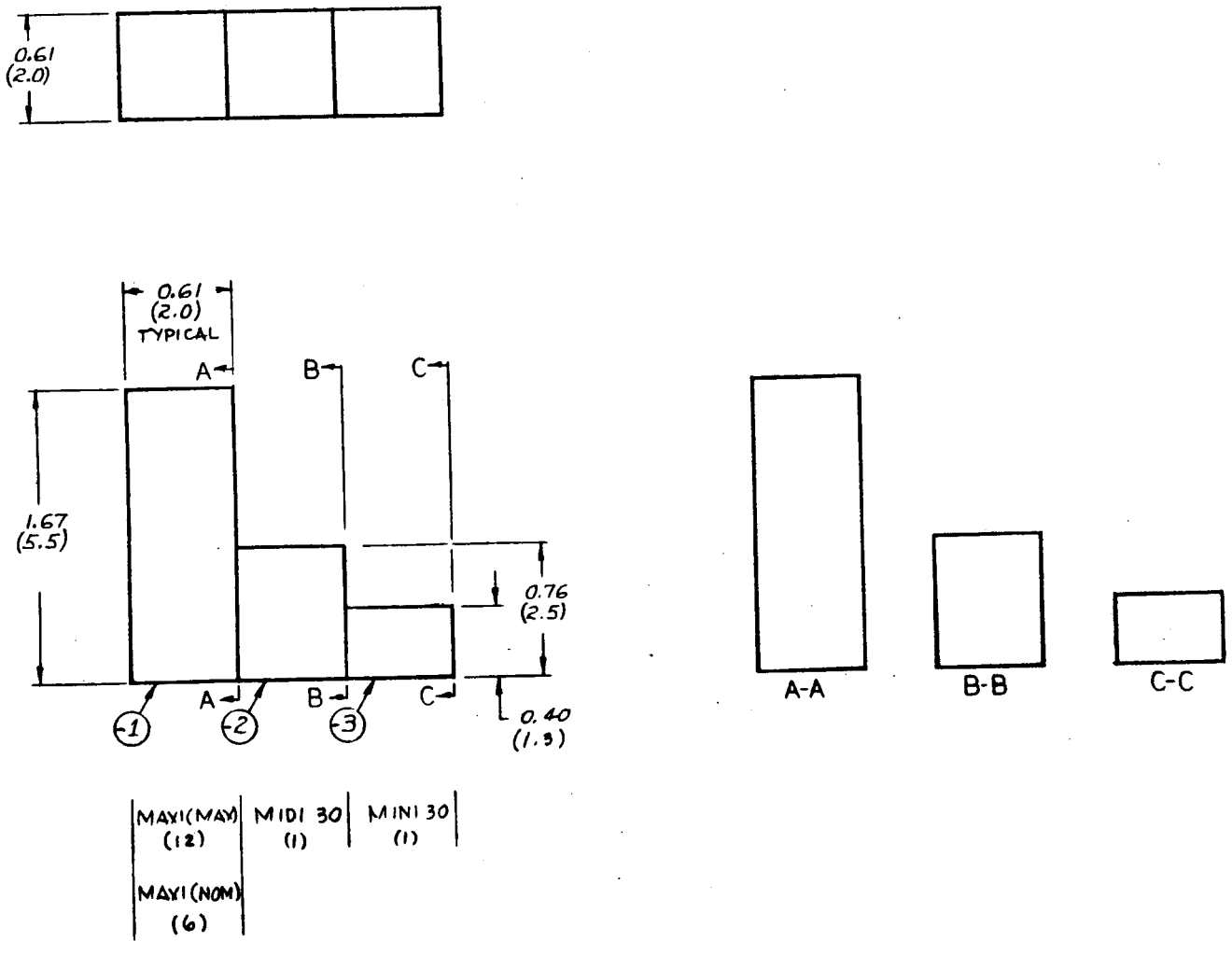


Figure I-22. Equipment Unit EU110 Animal Environmental Control System (Sheet 1)

EI NO.	NAME	MAXI MAX	MAXI NOM	MIDI 30	MINI 30	MINI 7	REMARKS
	CO_2 Concentrator	1	1	0	0	0	
	Bosch Reactor	1	1	0	0	0	
	Water Electrolysis Unit	1	1	0	0	0	
	Catalytic Oxidizer	1	1	0	0	0	
	Ducting, Blowers and Filters	1 Set	1 Set	1 Set	1 Set	1 Set	
	Multifiltration Water Purification Unit	1	1	1	1	0	
	Waste Storage Cabinets	1 Set	1 Set	1 Set	0	0	
	Food Storage Cabinets	1 Set	1 Set	1 Set	0	0	
			Weight power and volume of all these items are different - For example 1 Bosch for Maxi-Maxi ≠ 1 Bosch for Maxi-Norm				

Figure I-22. Equipment Unit EU110 Animal Environmental Control System (Sheet 2)

I. 2 WEIGHT AND VOLUME BREAKDOWN BY EQUIPMENT UNIT (EU)

The weight and volume for the baseline payload equipment units have been summarized in Tables I-1 through I-4.

Column 4 (titled manual) indicates an input requirement for the design sensitive equipment items.

C.2.

Table I-1. Weight and Volume Breakdown - Maxi-Max Payload Based on 9-27-71 Tab Run

EU NO.	NAME	COMPUTER PRINT+	MANUAL=	SUB TOTAL+	EQUIP. RACK	=TOTAL	RACK DIMENSIONS FT.	VOLUME FT^3
001-1	Visual Records & Microscopy		—		66		2 x 2 x 6.56	26
-2					66		2 x 2 x 6.56	26
EU Totals		2,057	-0-	2,057	132	2,189		52
002-1	Data Management Unit				66		2 x 2 x 6.56	26
-2					66		2 x 2 x 2.56	26
-4					66		2 x 2 x 2.56	26
EU Totals		1,202**	1,630**	2,832	198	3,030		78
003-1	Life Sciences Experiment Support Unit				66		2 x 2 x 6.56	26
EU Totals		992	100	1,092	66	1,158		26
004-1	Preparation & Preservation Unit				66		2 x 2 x 6.56	26
-2					66		2 x 2 x 6.56	26
-3					66		2 x 2 x 6.56	26
-4					66		2 x 2 x 6.56	26
-13					—		3.17 x 4.0 x 1.5	(19 x 2 = 38.0)
EU Totals		4, 125	-0-	4,125	264	4,389		142
005-1	Biochemical & Biophyics Analysis Unit				66		2 x 2 x 6.56	26
-2					66		2 x 2 x 6.56	26
EU Totals		1,853	80	1,933	132	2,065		52
006-1	Maintenance Repair & Fabrication Unit				66		2 x 2 x 6.56	26
-2					66		2 x 2 x 6.56	26
-3					66		2 x 2 x 6.56	26
EU Totals		882	-0-	882	198	1,080		78
007-	Ancillary Storage				—		Volume contained in other equipment units	
EU Totals		375	-0-	375	-0-	375		—

**Post run update.

Table I-1. Weight and Volume Breakdown - Maxi-Max Payload Based on 9-27-71 Tab Run, Contd

EU NO.	NAME	COMPUTER PRINT +	MANUAL =	SUB TOTAL +	EQUIP. RACK	= TOTAL	RACK DIMENSIONS FT.	VOLUME FT^3
011-1	Remote Manipulator				28		2 x 2 x 2.8	11.2
-2					28		2 x 2 x 2.8	11.2
Operating Space		—	—	—	—		3 x 4 x 4	48.0
EU Totals		1,212	-0-	1,212	56	1,268		70.4
012-1	Body Mass Measurement				—		1.83 x 3.0 x 4.0	22
-2	Rotating Litter Chair				—		2.67 x 7.0 x 7.0	131
EU Totals		963	-0-	963	-0-	963		153
012/031-1	Bio Medical Man-system Integration Research Support Unit				66		2 x 2 x 6.56	26
-2					66		2 x 2 x 6.56	26
	EU031	92						
EU Totals		92	-0-	92	132	224		52
025-	Radiation Exposure Unit	1,461			—		4.5 x 4.84 x 4.84	105
	EU026	605						
EU Totals		2,066	-0-	2,066	-0-	2,066		105
026-	Included in EU025							
030-1	Bicycle Ergometer				—		2.1 x 3.0 x 3.28	20.6
-2	Lower Body Negative Pressure				—		1.75 x 2.58 x 7.0	31.6
-3					—		0.50 x 0.67 x 0.83	0.28
EU Totals		185	-0-	185	-0-	185		52.5
031-	Included in EU 012/031							
040	Cage Module Vertebrate				17.0 x 32 = 545		1.71 x 1.79 x 2.17	6.65 x 32 = 213
EU Totals	For 32 Units	3,381	25	3,406	545	3,951		213
041-1	Primate Cylinder				—		2.5 x 2.5 x 5.0	31 x 2 = 62
-2	Primate Sphere				—		5.0 x 5.0 x 5.0	125
EU Totals	For Two-1 & One-2	1,350	-0-	1,350	-0-	1,350		187

Table I-1. Weight and Volume Breakdown - Maxi-Max Payload Based on 9-27-71 Tab Run, Contd

EU NO.	NAME	COMPUTER PRINT +	MANUAL =	SUB TOTAL +	EQUIP. RACK	= TOTAL	RACK DIMENSIONS FT	VOLUME FT^3
042-	Included in EU 042/071	-0-			—		—	—
042/071-1	Holding Unit Support				66		2 x 2 x 6.56	26
	EU042	339						
	EU051	185						
	EU061	112						
	EU071							
EU Totals		636	-0-	636	66	702		26
050-	Cage Module Plant				17.0 x 9 = 153		1.71 x 1.79 x 2.17	6.65 x 9 = 60
EU Totals	For 9 Units	980	-0-	980	153	1,133		60
051-	Included in EU042/071				—		—	—
060-	Cage Module Cell & Tissue				17.0 x 4 = 68		1.71 x 1.79 x 2.17	6.65 x 4 = 26.6
EU Totals	For 4 Units	489*	-0-	489	68	557		26.6
061-	Included in EU042/071				—		—	—
070-	Cage Module Invertebrate				17.0 x 3 = 51		1.71 x 1.79 x 2.17	6.65 x 3 = 20
EU Totals	For 3 Units	248	-0-	248	51	299		20
071-	Included in EU042/071				—		—	—
080-1	Life Support Subsystem Test Unit				66		2 x 2 x 6.56	26
-2					66		2 x 2 x 6.56	26
-4	Seat (Ignore)				—		—	—
-5	Shower EU 081	(10)			66		3 x 3 x 7.5 (Deployed)	67.5
EU Totals		331	-0-	331	198	529		120
081-	Included in EU080							

*489 lb will be changed to 289 lb on the next tab run.

Table I-1. Weight and Volume Breakdown - Maxi-Max Payload Based on 9-27-71 Tab Run, Contd

EU NO.	NAME	COMPUTER PRINT +	MANUAL =	SUB TOTAL +	EQUIP. RACK	= TOTAL	RACK DIMENSIONS FT.	VOLUME FT^3
091-1	Behavioral Measurements Unit				66		2 x 2 x 6.56	26
-2					66		2 x 2 x 6.56	26
EU Totals		719	-0-	719	132	851		52
093-1	Mobility Unit Damage Proof	13			—		4.92 x 6.56 x 14.75 (Deployed)	477
EU Totals		28	300	328	-0-	328		477
Payload Sub-Totals for Zero "G" LS-RAMS	lb	(24,166)	(2,135)	(26,301)	(2,391)	(28,692)		2,043 FT^3
	Kg	10,985	970	11,955	1,085	13,042		57.8 M^3
RESEARCH CENTRIFUGE PORTION OF MAXI (MAX) PAYLOAD								
040	Cage Module Vertebrate				17.0 x 32 = 545		1.71 x 1.79 x 2.17	6.65 x 32 = 213
EU Totals	For 32 Units	3,381	25	3,406	545	3,951		213
041-1	Primate Cylinder				—		2.5 x 2.5 x 5.0	31 x 2 = 62
-2	Primate Sphere				—		5.0 x 5.0 x 5.0	125
EU Totals	For Two-1 & One-2	1,350	-0-	1,350	-0-	1,350		187
042-	Included in EU 042/071	-0-			—		—	—
042/071-2	Holding Unit Support				66		2 x 2 x 6.56	26
	EU 042	339						
	EU 051	185						
	EU 061	112						
	EU 071							
EU Totals		636	-0-	636	66	702		26
050-	Cage Module Plant				17.0 x 9 = 153		1.71 x 1.79 x 2.17	6.65 x 9 = 60
EU Totals	For 9 Units	980	-0-	980	153	1,133		60
051-	Included in EU042/071				—		—	—
060-	Cage Module Cell & Tissue				17.0 x 4 = 68		1.71 x 1.79 x 2.17	6.65 x 4 = 26.6
EU Totals	For 4 Units	489*	-0-	489	68	557		26.6

*489 lb will be changed to 289 lb on the next tab run.

Table I-1. Weight and Volume Breakdown - Maxi-Max Payload Based on 9-27-71 Tab Run, Contd

EU NO.	NAME	COMPUTER PRINT +	MANUAL =	SUB TOTAL +	EQUIP. RACK	= TOTAL	RACK DIMENSIONS FT.	VOLUME FT^3
061-	Included in EU042/071				–		–	–
070-	Cage Module Invertebrate				17.0 x 3 = 51		1.71 x 1.79 x 2.17	6.65 x 3 = 20
EU Totals	For 3 Units	248	-0-	248	51	299		20
071-	Included in EU042/071				–		–	–
091-1	Behavioral Measurements Unit				66		2 x 2 x 6.56	26
-2					66		2 x 2 x 6.56	26
EU Totals		719	-0-	719	132	851		52
120	Habitability Equipment		500					78
EU Totals		-0-	500	500	-0-	500		78 FT^3
Research Centrifuge lb		7,803	525	8,328	1,515	9,343		863 FT^3
Payload SubTotals Kg		3,540	238	3,780	688	4,240		24.5 M^3
Payload lb		31.969	2,660	34,629	3,906	38,035		2,906 FT^3
Grand Totals Kg		14,531	1,209	15,740	1,773	17,289		82.3 M^3

Table I-2. Weight and Volume Breakdown Maxi-Nom Payload 9-28-71 Tab Run

EU NO.	NAME	COMPUTER PRINT+	MANUAL=	SUB TOTAL+	EQUIP. RACK	=TOTAL	RACK DIMENSIONS FT	VOLUME FT^3
001-	Visual Records & Microscopy							
-3					66		2 x 2 x 6.56	26
EU Totals		1,048	-0-	1,048	66	1,114		26
002-	Data Management Unit							
-3					66		2 x 2 x 6.56	26
-5					41		2 x 2 x 4.0	16
EU Totals		418**	1,132	1,550	107	1,657		42
003-1	Life Sciences Experiment Support Unit				66		2 x 2 x 6.56	26
-2					51		2 x 2 x 5	20
-3					44		2 x 2 x 4	16
EU Totals		761	50	811	161	972		62
004-1	Preparation & Preservation Unit				66		2 x 2 x 6.56	26
-2					66		2 x 2 x 6.56	26
-3					66		2 x 2 x 6.56	26
-4					66		2 x 2 x 6.56	26
-13					—		3.17 x 4.0 x 1.5	19
EU Totals		2,930	-0-	2,930	264	3,194		123
005-1	Biochemical & Biophyics Analysis Unit				66		2 x 2 x 6.56	26
-2					66		2 x 2 x 6.56	26
EU Totals		1,369	32	1,401	132	1,533		52
006-1	Maintenance Repair & Fabrication Unit				66		2 x 2 x 6.56	26
-2					66		2 x 2 x 6.56	26
-3					66		2 x 2 x 6.56	26
EU Totals		711	-0-	711	198	909		78

**Post run update

Table I-2. Weight and Volume Breakdown Maxi-Nom Payload 9-28-71 Tab Run, Contd

EU NO.	NAME	COMPUTER PRINT+	MANUAL=	SUB TOTAL+	EQUIP. RACK	=TOTAL	RACK DIMENSIONS FT	VOLUME FT^3
007-	Ancillary Storage				—		Volume contained in other equipment units	
EU Totals		260	-0-	260	—	260		—
011-1	Remote Manipulator				33		2 x 2 x 2.8	11.2
-2					33		2 x 2 x 2.8	11.2
Operating Space		—	—	—	—		3 x 4 x 4	48.0
EU Totals		572	-0-	572	66	638		70
012-1	Body Mass Measurement				—		1.83 x 3.0 x 4.0	22
-2	Rotating Litter Chair				—		2.67 x 7.0 x 7.0	131
EU Totals		895	-0-	895	-0-	895		153
012/031-1	Bio Medical Man-System Integration Research Support Unit				66		2 x 2 x 6.56	26
-2	EU 031				66		2 x 2 x 6.56	26
EU Totals		81	-0-	81	132	213		52
021-	Internal Centrifuge Slipring System	Included in EU 023						
023-	Internal Centrifuge EU 021	500 200						
EU Totals		700	-0-	700	-0-	700	3.0 x 12.0 dia	340
025-	Radiation Exposure Unit	177			—			
	EU 026	280						
EU Totals		457	-0-	457	-0-	457		-0-
026-	Included in EU 025							

Table I-2. Weight and Volume Breakdown Maxi-Nom Payload 9-28-71 Tab Run, Contd

EU NO.	NAME	COMPUTER PRINT +	MANUAL =	SUB TOTAL +	EQUIP. RACK	= TOTAL	RACK DIMENSIONS FT	VOLUME FT^3
030-1	Bicycle Ergometer				—		2.1 x 3.0 x 3.28	20.6
-2	Lower Body Negative Pressure				—		1.75 x 2.58 x 7.0	31.6
-3	Exergenie				—		.50 x .67 x .83	.28
EU Totals		185	-0-	185	-0-	185		52
031-	Included in EU 012/031							
040-	Cage Module Vertebrate				17 x 8 = 136		1.71 x 1.79 x 2.17	6.65 x 8 = 53
EU Totals	For 16 Units	1,982*	20	2,002	136	2,138		53
		*Tab Run Erroneously Shows 7,062 lb						
041-1	Primate Cylinder				—		2.5 x 2.5 x 5.0	31 x 2 = 62
EU Totals	For Two -1	1,320	-0-	1,320	-0-	1,320		62
042-	Included in EU 042/071							
042/071-3	Holding Unit Support				66		2 x 2 x 6.56	26
	EU 042	279						
	EU 051	195						
	EU 061	146						
EU Totals		630	-0-	630	66	696		26
050-	Cage Module Plant				17.0 x 8 = 136		1.71 x 1.79 x 2.17	6/65 x 8 = 53
EU Totals	For 8 Units	920	-0-	920	136	1,056		53
051-	Included in EU 042/071							
060-	Cage Module Cell & Tissue				17.0 x 2 = 34		1.71 x 1.79 x 2.17	6.65 x 2 = 13
EU Totals	For 2 Units	550	-0-	550	34	584		13
061-	Included in EU 042/071							
070-	Cage Module Invertebrate				17.0 x 2 = 34		1.71 x .179 x 2.17	6.65 x 2 = 13
EU Totals	For 2 Units	172	-0-	172	34	206		13

Table I-2. Weight and Volume Breakdown Maxi-Nom Payload 9-28-71 Tab Run, Contd

EU NO.	NAME	COMPUTER PRINT+	MANUAL=	SUB TOTAL+	EQUIP. RACK	=TOTAL	RACK DIMENSIONS FT	VOLUME FT^3
080-1	Life Support Subsystem Test Unit				66		2 x 2 x 6.56	26
-2					66		2 x 2 x 6.56	26
-4	Seat (ignore)				—		—	—
-5	Shower				66		3 x 3 x 7.5 (Deployed)	67.5
EU Totals		168	-0-	168	198	366		146
081-	Included in EU 080							
091-1	Behavioral Measurements Unit				66		2 x 2 x 6.56	26
-2					66		2 x 2 x 6.56	26
EU Totals		421	-0-	421	132	553		52
093-1	Mobility Unit Damage Proof				—		4.92 x 6.56 x 14.75 (Deployed)	477
EU Totals		12	300	312	-0-	312		
Totals	Pounds	16,562	1,534	18,194	1,862	19,958		1,945 FT^3
	Kilograms	7,528	697	8,270	845	9,072		55.2 M^3

Table I-3. Weight and Volume Breakdown Mini-30 Payload 9-27-71 Tab Run

EU NO.	NAME	COMPUTER PRINT+	MANUAL=	SUB TOTAL+	EQUIP. RACK	=TOTAL	RACK DIMENSIONS FT	VOLUME FT^3
001-	Visual Records & Microcopy							
-4					66		2 x 2 x 6.56	26
EU Totals		554	-0-	554	66	620		26
002-	Data Management Unit							
-3					66		2 x 2 x 6.56	26
-6					22		2 x 2 x 2	8
EU Totals		169**	675**	844	88	932		34
003-	Life Sciences Experiment Support Unit							
-3					44		2 x 2 x 2	16
EU Totals		523	35	558	44	602		16
004-	Preparation & Preservation Unit							
-9					66		2 x 2 x 6.56	26
-10					66		2 x 2 x 6.56	26
-13					—		3.17 x 4.0 x 1.5	19
EU Totals		2,096	-0-	2,096	132	2,228		71
005-	Biochemical & Biophyics Analysis Unit							
-4					66		2 x 2 x 6.56	26
EU Totals		1,000	24	1,024	66	1,090		26
006-	Maintenance Repair & Fabrication Unit							
-5					66		2 x 2 x 6.56	26
-6					66		2 x 2 x 6.56	26
EU Totals		586	-0-	586	132	718		52
007-	Ancillary Storage				—		Volume contained in other equipment units	
EU Totals		134	-0-	134	-0-	134		

**Post run update

Table I-3. Weight and Volume Breakdown Mini-30 Payload 9-27-71 Tab Run, Contd

EU NO.	NAME	COMPUTER PRINT+	MANUAL=	SUB TOTAL+	EQUIP. RACK	=TOTAL	RACK DIMENSIONS FT	VOLUME FT^3
011-1	Remote Manipulator				33		2 x 2 x 2.8	11.2
-2					33		2 x 2 x 2.8	11.2
Operating Space		—	—	—	—		3 x 4 x 4	48.0
EU Totals		540	-0-	540	66	606		70
012-1	Body Mass Measurement				—		1.83 x 3.0 x 4.0	22
-2	Rotating Litter Chair				—		2.67 x 7.0 x 7.0	131
EU Totals		774	-0-	774	-0-	774		153
012/031-1	Bio Medical Man-system Integration Research Support Unit				66		2 x 2 x 6.56	26
-2					66		2 x 2 x 6.56	26
	EU 031	73						
EU Totals		73	-0-	73	132	205		52
025-	Radiation Exposure Unit	146			—		4.5 x 4.84 x 4.84	105
	EU 026	280						
EU Totals		426	-0-	426	-0-	426		105
026-	Included in EU 025							
030-1	Bicycle Ergometer				—		2.1 x 3.0 x 3.28	20.6
-2	Lower Body Negative Pressure				—		1.75 x 2.58 x 7.0	31.6
-3	Exergenie				—		.50 x .67 x .83	.28
EU Totals		184	-0-	184	-0-	184		53
031	Included in EU 012/031							
040-	Cage Module Vertebrate				17 x 2 = 34		1.71 x 1.79 x 2.17	6.65 x 2 = 13
EU Totals	For 2 Units	268	10	278	34	312		13
041-1	Primate Cylinder				—		2.5 x 2.5 x 5.0	31 x 2 = 62
EU Totals	For Two-1	360	-0-	360	-0-	360		62

Table I-3. Weight and Volume Breakdown Mini-30 Payload 9-27-71 Tab Run, Contd

EU NO.	NAME	COMPUTER PRINT+	MANUAL=	SUB TOTAL+	EQUIP. RACK	=TOTAL	RACK DIMENSIONS FT	VOLUME FT^3
042	Included in EU 042/071							
042/071-	Holding Unit Support							
	EU 042	51						
	EU 051	78						
	EU 061	76						
-4					31		2 x 2 x 3	12
EU Totals		205	-0-	205	31	236		12
050-	Cage Module Plant				17.0		1.71 x 1.79 x 2.17	6.65
EU Totals	For 1 Unit	180	-0-	180	17	197		7.0
051-	Included in EU 042/071							
060-	Cage Module Cell & Tissue				17 x 2 = 34		1.71 x 1.79 x 2.17	6.65 x 2 = 13
EU Totals	For 2 Units	141	-0-	141	34	175		13
061-	Included in EU 042/071				—		—	—
070-	Cage Module Invertebrate				17.0		1.71 x 1.79 x 2.17	6.65
EU Totals	For 1 Unit	85	-0-	85	17	102		7
080-1	Life Support Subsystem Test Unit				66		2 x 2 x 6.56	26
-2					66		2 x 2 x 6.56	26
-4	Seat (ignore)							
EU Totals		117	-0-	117	132	249		52
091-1	Behavioral Measurements Unit				66		2 x 2 x 6.56	26
EU Totals		377	-0-	377	132	509		52
093-	Mobility Grid							
EU Totals		4	-0-	4	-0-	4		Neg
Totals	Pounds	8,796	744	9,540	1,123	10,663		876 FT^3
	Kilograms	3,998	338	4,336	510	4,847		24.8 M^3

Table I-4. Weight and Volume Breakdown - Mini-7 Payload Based on 9-27-71 Tab Run

EU NO.	NAME	COMPUTER PRINT +	MANUAL =	SUB TOTAL +	EQUIP. RACK	= TOTAL	RACK DIMENSIONS FT.	VOLUME FT^3
001-5	Visual Records & Microscopy		—		33		2 x 2 x 3.0	12
EU Totals		513	20	533	33	566		12
002-3	Data Management Unit				66		2 x 2 x 6.56	26
-6					22		2 x 2 x 2.0	8
EU Totals		136**	333**	469	88	557		34
003-3	Life Sciences Experiment Support Unit						2 x 2 x 4.0	16
EU Totals		311	-0-	311	44	355		16
004-11	Preparation & Preservation Unit				66		2 x 2 x 6.56	26
-12					66		2 x 2 x 6.56	26
-13							3.17 x 4.0 x 1.5	19.0
EU Totals		947	-0-	947	132	1,079		71
005-5	Biochemical & Biophyics Analysis Unit				66		2 x 2 x 6.56	26
EU Totals		459	-0-	459	66	525		26
006-7	Maintenance Repair & Fabrication Unit				66		2 x 2 x 6.56	26
-8					66		1.8 x 2.17 x 1.7	7
EU Totals		387	-0-	387	132	453		33
007-	Ancillary Storage				—		Volume contained in other equipment units	
EU Totals		120	-0-	120	-0-	120		—
011-1	Remote Manipulator				28		2 x 2 x 2.8	11.2
-2					28		2 x 2 x 2.8	11.2
Operating Space		—	—	—	—		3 x 4 x 4	48.0
EU Totals		562	-0-	562	56	618		70.4
012/031-3	Bio Medical Man-system Integration Research Support Unit				50		2 x 2 x 4.6	17
EU Totals		65	20	85	50	135		17

**Post run update

Table I-4. Weight and Volume Breakdown - Mini-7 Payload Based on 9-27-71 Tab Run, Contd

EU NO.	NAME	COMPUTER PRINT +	MANUAL =	SUB TOTAL +	EQUIP. RACK	= TOTAL	RACK DIMENSIONS FT.	VOLUME FT^3
025-	Radiation Exposure Unit				—		Stored in Regrigerator (EU 004)	
EU Totals		111	-0-	111	-0-	111		
042-	Included in EU 042/071	-0-			—		—	—
042/071-4	Holding Unit Support				66		2 x 2 x 3.0	12
	EU042	16.6						
	EU051	75.6						
	EU061	46.0						
EU Totals		138	-0-	138	33	171		12
050-	Cage Module Plant				66		2 x 2 x 6.56	26
EU Totals	For 1 Unit	95	-0-	95	66	161		26
051-	Included in EU042/071				—		—	—
060-	Cage Module Cell & Tissue				In EU050 Rack		In EU050 Rack	
EU Totals	For 2 Units	141	-0-	141	-0-	141		-0-
061-	Included in EU042/071				—		—	—
070-	Cage Module Invertebrate				In EU050 Rack		In EU050 Rack	
EU Totals	For 1 Unit	85	-0-	85		85		-0-
080-3	Life Support Subsystem Test Unit				66		2 x 2 x 6.56	26
-4	Sea (Ignore)				—		—	—
EU Totals		97	-0-	97	66	163		26
091-2	Behavioral Measurements Unit				66		2 x 2 x 6.56	26
EU Totals		105	-0-	105	66	171		26
Payload Totals	(lb)	4,272	373	4,645	776	5,421		388 Ft^3
	Kg	1,942	170	2,111	352	2,464		11.0M^3

I. 3 FIRST GENERATION LAYOUT DATA

This section documents the first generation payload layouts for the following payloads (see Figures I-23 through I-37):

Maxi Max

Midi-56

Mini-56

Midi-30

Mini-30

Mini-7

Figure I-38 shows a special case (data point) BLH Module layout depicting a maximum volume configuration to minimize experiment envelope overlap. Figure I-39 shows the case where all the CORE units are placed in the BLH module. The Maxi Max external centrifuges, and the human centrifuge are shown in Figures I-40, I-41, and I-42 respectively.

I. 3. 1 FIRST GENERATION PAYLOAD LAYOUTS. The first generation payload layouts are accompanied by a table describing module size, required Shuttle launches, costs, and total facility weights and volumes.

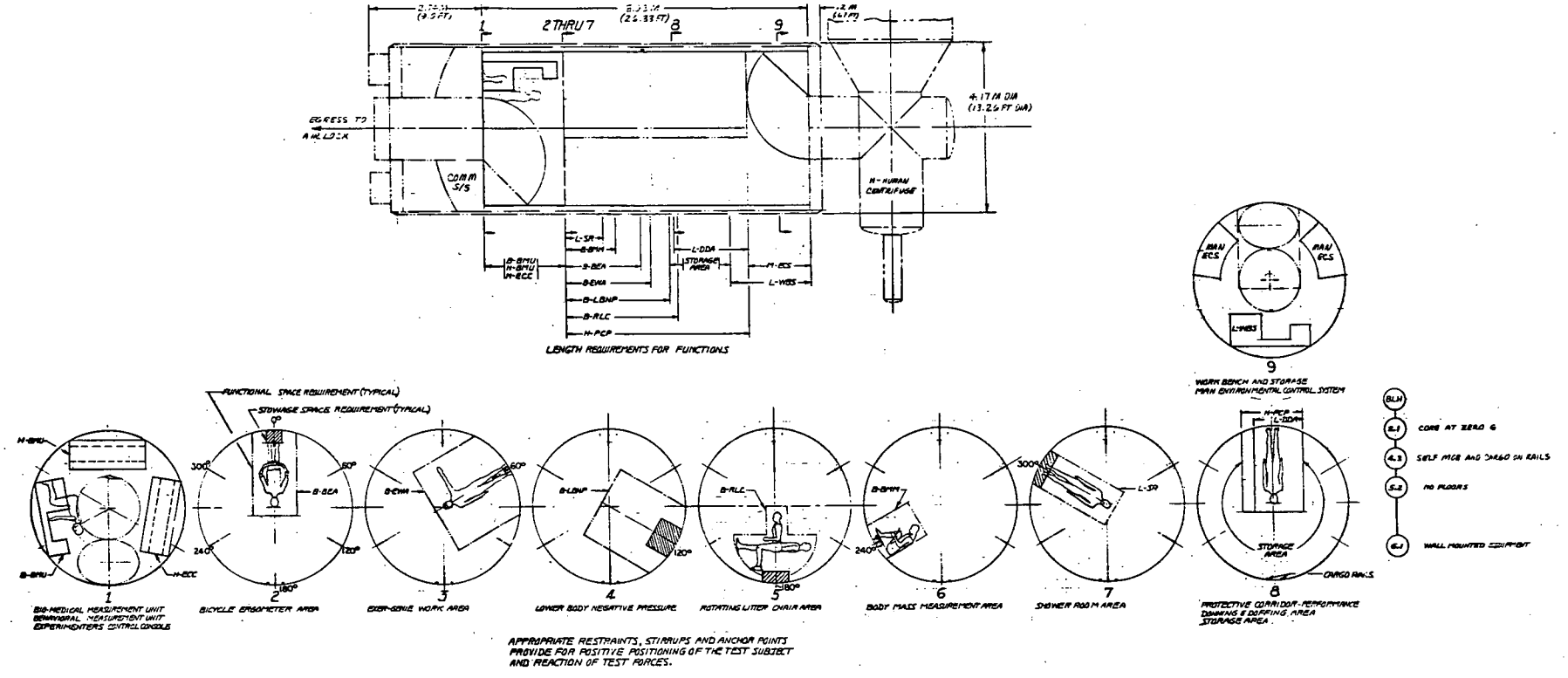


Figure I-23. Concept No. 1, BLH Module - Sheet 1

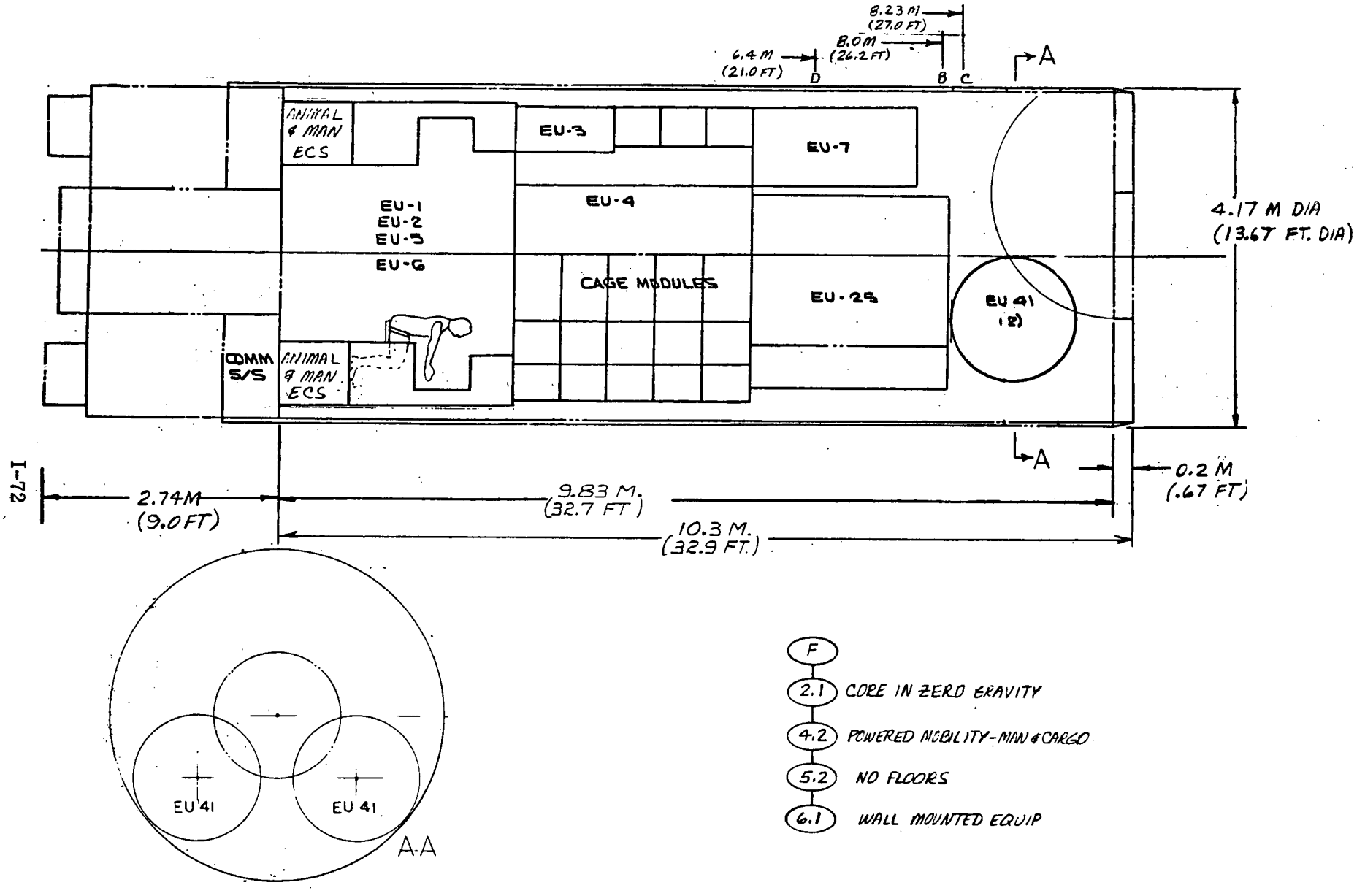
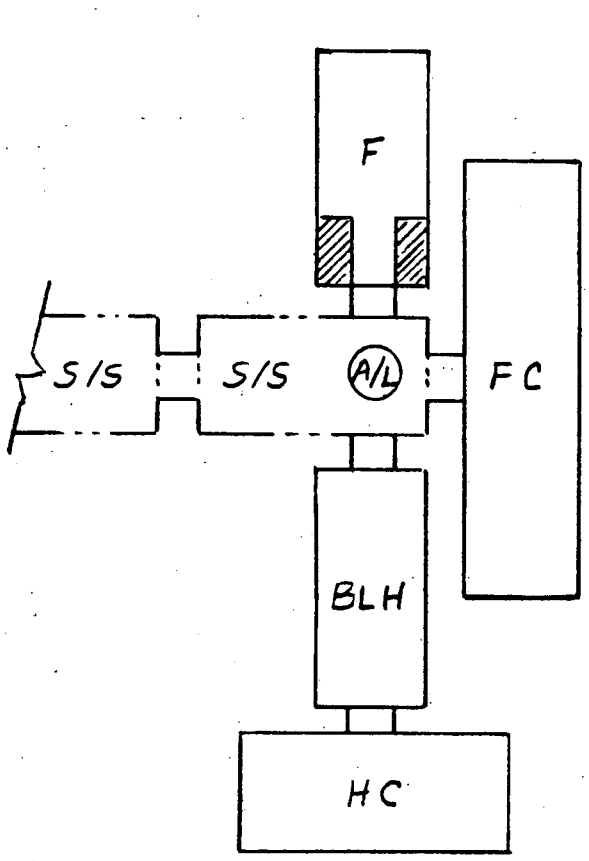
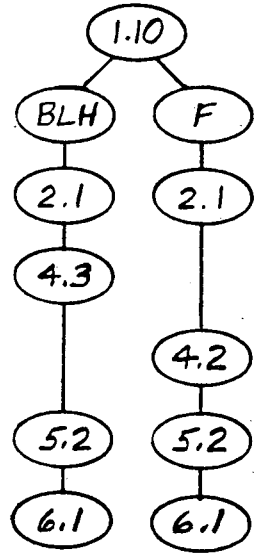


Figure I-23. Concept No. 1, F Module - Sheet 2



COG-6



B+L+H AND F

CORE IN ZERO GRAVITY

SELF MOB & CARGO ON RAILS

POWERED MOBILITY-MAN & CARGO

NO FLOORS

WALL MOUNTED EQUIP.

ALTERNATES:
COG-4
COG-7
COG-8
COG-9
COG-10

Figure I-23. Concept No. 1, Module Cluster - Sheet 3

* REFER TO FIG 24 FOR DEFINITION OF PERTURBATION

FIRST GENERATION CONCEPT NO. 1

DES. CONF. #	MODULE TYPE	SIZE OF MODULE REQ'MTS: # OF MOD.	LENGTH (FT)	VOLUME (FT^3)	WEIGHT x1000: MOD. STRUCT.	INTERFACE STRUCT.	COMMON SUBSYS.	ECS	CONSUM.[2]	TOTAL[3]	SCIENTIFIC & SUPPORT EQUIPMENT PAYLOAD: VOLUME (FT^3)	WEIGHT (LBS, x1000)	SCS RES.	SHUTTLE LAUNCHES REQ'D: WEIGHT OF DEDICATED LAUNCHES	WEIGHT OF CARGO LAUNCHES	TOTAL # OF LNCHS	MODULE AND SUBSYS.	COSTS ($M of $): SCIENTIFIC & SUPPORT EQUIP. DEV.	SCIENTIFIC & SUPPORT EQUIP. UNIT	LAUNCH MOD.	LAUNCH CARGO	TOTAL	TOTAL FACILITY VOLUME (FT^3)	TOTAL FACILITY WEIGHT[3] (LBS, x1000)	ε_v[1]	$/# P/L
1	F	1	42.4	3901	9.9	4.8	2.7	0.2 (CREW) 2.2 (EXP)	1.1	20.9	784 544 80	16.3 10.3 (CORE) 5.3 (EU 25-26)	100%	25.0	27.8	2.8	18.3	14.4 58.8 9.8	8.0 18.4 0.7	5.0	8.9	142.3	3901	52.8	0.36	0.60
	BLH	1	36.0	3138	9.1	1.2	2.7	0.7 (CREW)	0.1	13.8	179 106	2.2 1.1 (EU II)	100%	17.1	—	1.0	17.2	7.1 0.3	7.1 0.2	5.0	—	36.9	3138	17.1	0.09	0.19
	FC	1	60.0	5364	10.1	1.5	3.1	0.2 2.9	1.5	19.3	336	7.0	100%	25.0	1.3	1.1	10.0	6.2	3.5	5.0	.4	25.1	5364	26.3	0.06	0.27
	HC	1		2045						23.7	54	0.4	100%	24.1	—	1.0	153.4	1.2	0.2	5.0	—	159.8	2045	24.1	0.03	0.02
	TOTAL	4		14,448						77.7	2083	42.6	100%	91.2	29.1	5.9	198.9	97.8	38.1	20.0	9.3	364.1	14,448	120.3	0.14	0.35
* 1A	F	1		SAME AS CONCEPT 1										25.0	27.8	2.8	18.3	83.0	27.1	5.0	8.9	142.3				
	BLH	1		SAME AS CONCEPT 1										17.1	—	1.0	17.2	7.4	7.3	5.0	—	36.9				
	RC	1	60.0	5364	10.1	1.5	3.1	0.2 2.9	1.5	19.3	336	7.0	HC/RC	25.0	1.3	1.1	153.4	6.2	3.5	5.0	.4	168.5	5364	26.3	0.06	0.27
	TOTAL	3		12,403						54.0	2029	42.2	HC/RC	67.1	29.1	4.9	188.9	96.6	37.9	15.0	9.3	347.7	12,403	96.2	0.16	0.44
1B	F	1	35.9	3126	9.1	4.0	2.7	0.2 (CREW) 2.2 (EXP)	1.1	19.3	784 544	16.3 10.3 (CORE)	EU 25	25.0	20.9	2.3	17.8	14.4 58.8	8.0 18.4	5.0	6.7	129.1	3126	45.9	0.42	0.58
	BLH	1		SAME AS CONCEPT 1										17.1	—	1.0	17.2	7.4	7.3	5.0	—	36.9				
	RC	1		SAME AS CONCEPT 1A										25.0	1.3	1.1	153.4	6.2	3.5	5.0	.4	168.5				
	TOTAL	3		11,628						52.4	1049	36.9	HC/RC EU 25	67.1	22.2	4.4	188.4	86.8	37.2	15.0	7.1	234.5	11,628	89.3	0.17	0.41
1C	F	1	36.7	3221	9.2	4.4	2.7	0.2 (CREW) 2.2 (EXP)	1.1	19.8	607 544 80	13.4 10.3 (CORE) 5.3 (EU 25-26)	24CM	25.0	23.8	2.5	17.9	14.4 58.8 9.8	7.8 18.4 0.7	5.0	7.6	140.4	3221	48.8	0.38	0.59
	BLH	1		SAME AS CONCEPT 1										17.1	—	1.0	17.2	7.4	7.3	5.0	—	36.9				
	RC	1		SAME AS CONCEPT 1A										25.0	1.3	1.1	153.4	6.2	3.5	5.0	.4	168.5				
	TOTAL	3		11,723						52.9	1852	39.3	HC/RC 24CM	67.1	25.1	4.6	138.5	96.6	37.7	15.0	8.0	345.2	11,723	92.2	0.16	0.43
1D	F	1	30.7	2505	8.5	3.6	2.7	0.2 (CREW) 2.2 (EXP)	1.1	18.3	607 544	13.4 10.3 (CORE)	24CM EU25	25.0	17.0	2.1	17.5	14.4 58.8	7.8 18.4	5.0	5.4	127.3	2505	42.0	0.46	0.56
	BLH	1		SAME AS CONCEPT 1										17.1	—	1.0	17.2	7.4	7.3	5.0	—	36.9				
	RC	1		SAME AS CONCEPT 1A										25.0	1.3	1.1	153.4	6.2	3.5	5.0	.4	168.5				
	TOTAL	3		11,007						51.4	1772	34.0	HC/RC 24CM EU25	67.1	18.3	4.2	188.1	86.8	37.0	15.0	5.5	332.7	11,007	85.4	0.16	0.40

[1] BASED ON INSIDE USABLE DIAMETER. EXCLUDES COMMON SUBSYSTEMS COMPARTMENT.

[2] ASSUMES 90-DAY RESUPPLY

[3] EXCLUDES AIRLOCK

Figure I-23. Concept No. 1, Sheet 4

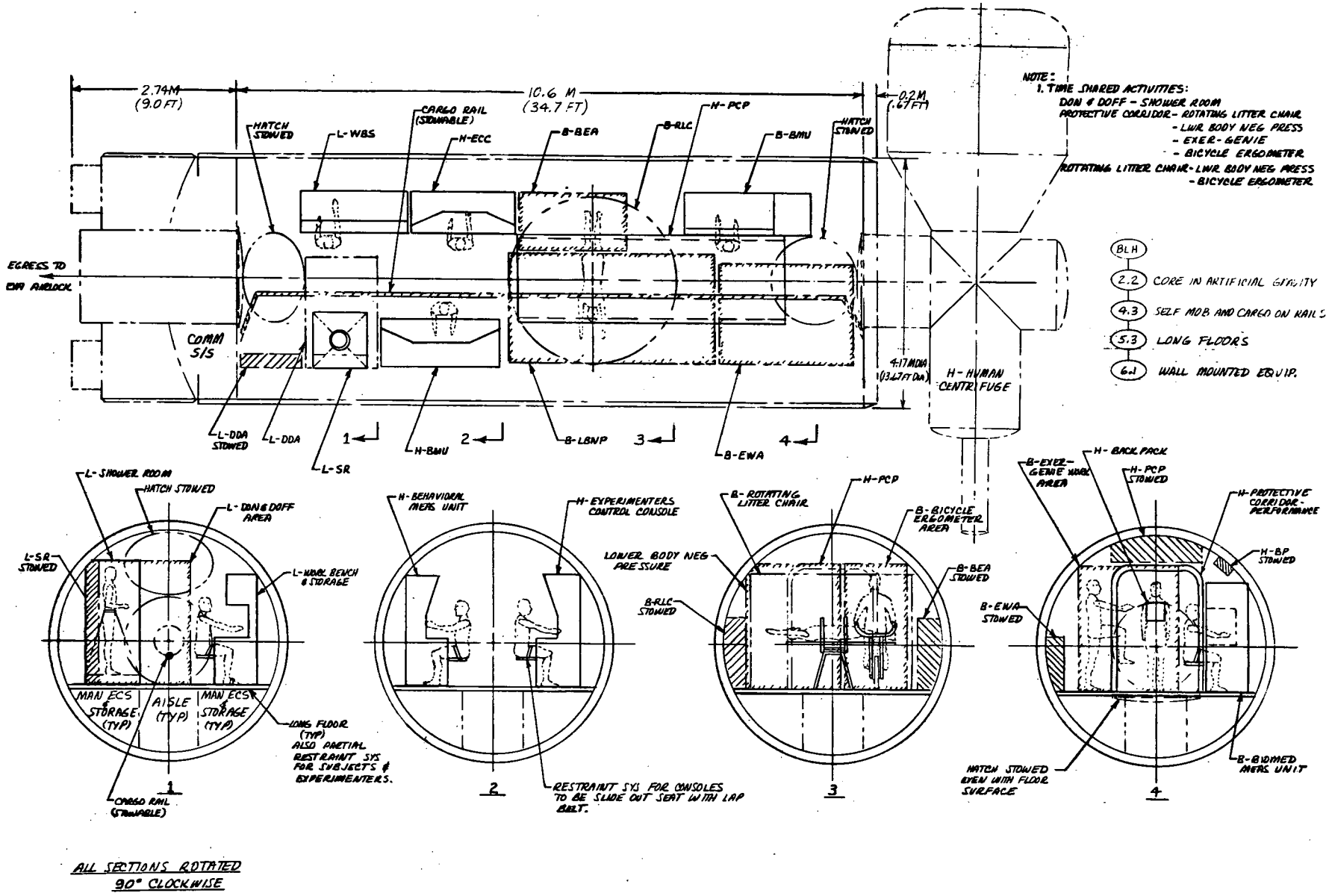


Figure I-24. Concept No. 2, BLH Module - Sheet 1

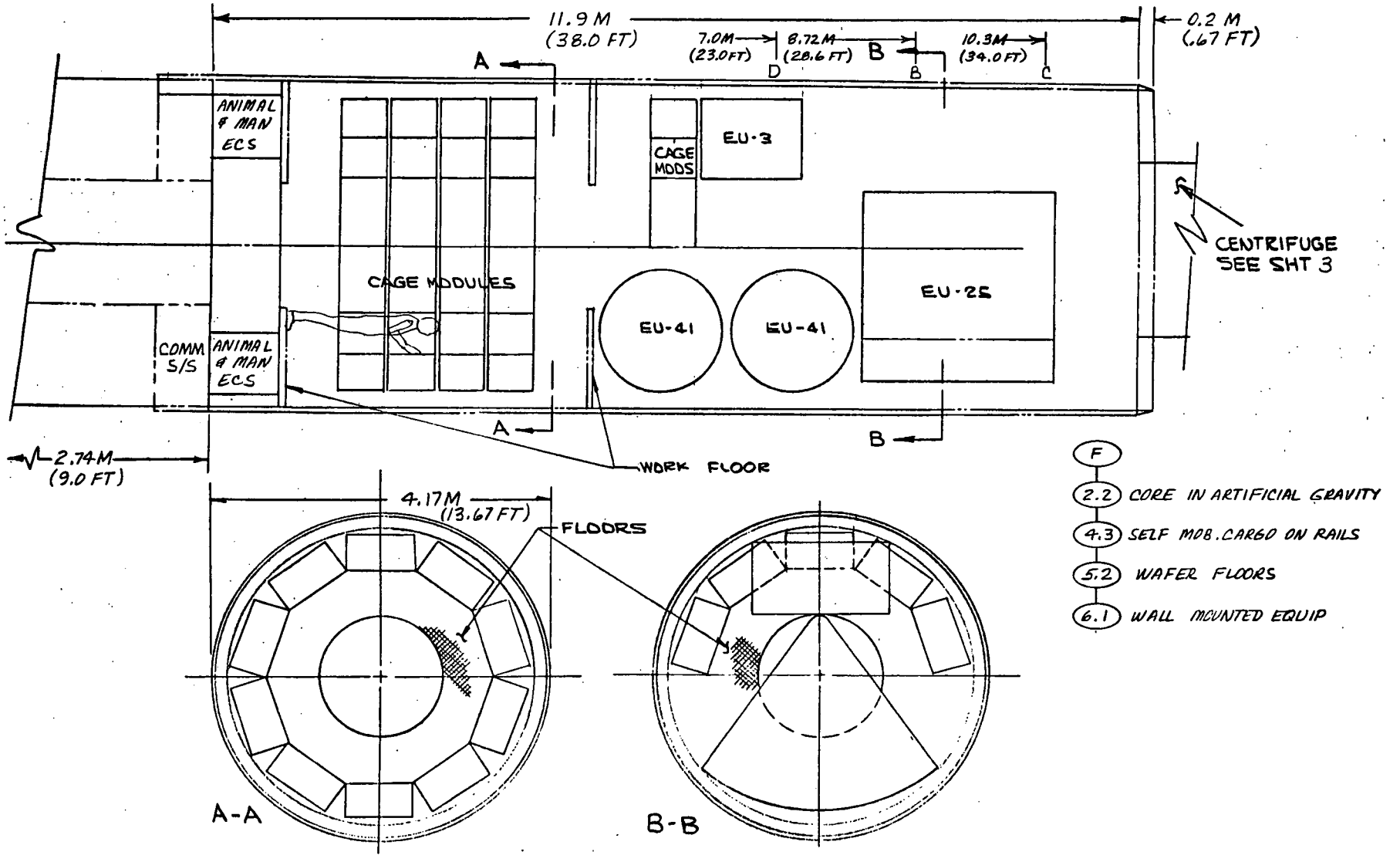


Figure I-24. Concept No. 2, F Module - Sheet 2

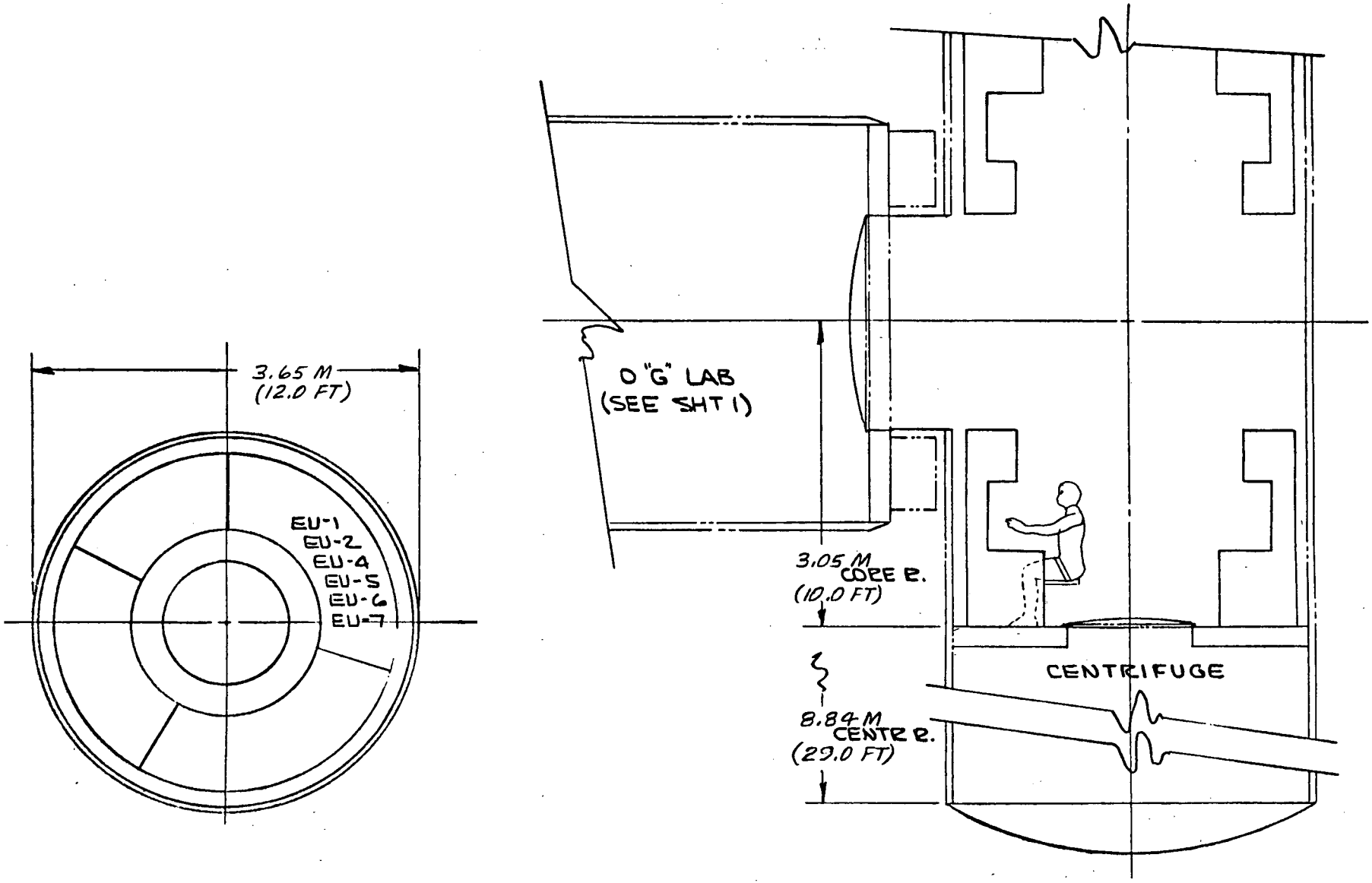
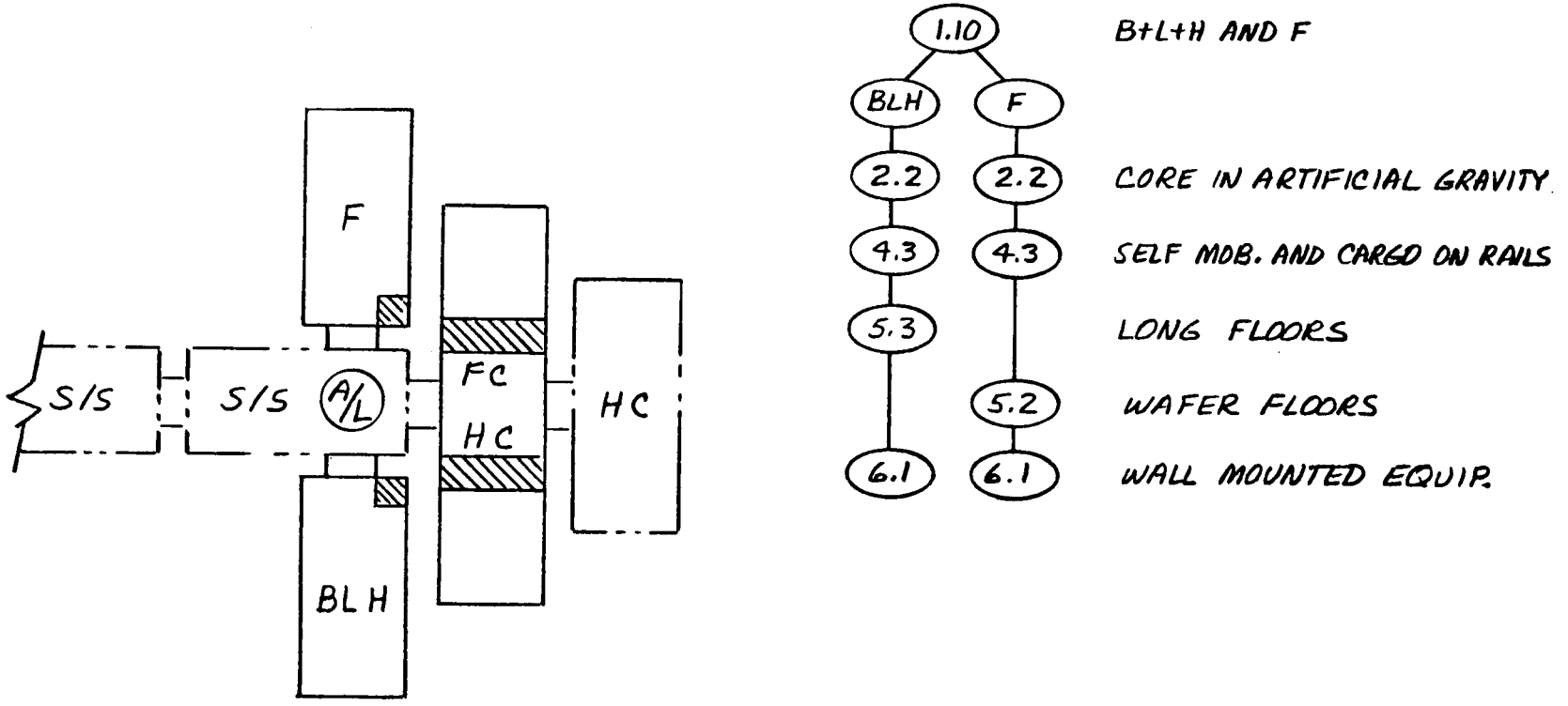


Figure I-24. Concept No. 2, F Module - Sheet 3



ALTERNATES:
CAG-1 CAG-8
CAG-3 CAG-9
CAG-4 CAG-10
CAG-5 CAG-11

CAG-6

Figure I-24. Concept No. 2, Module Cluster - Sheet 4

FIRST GENERATION CONCEPT NO. 2

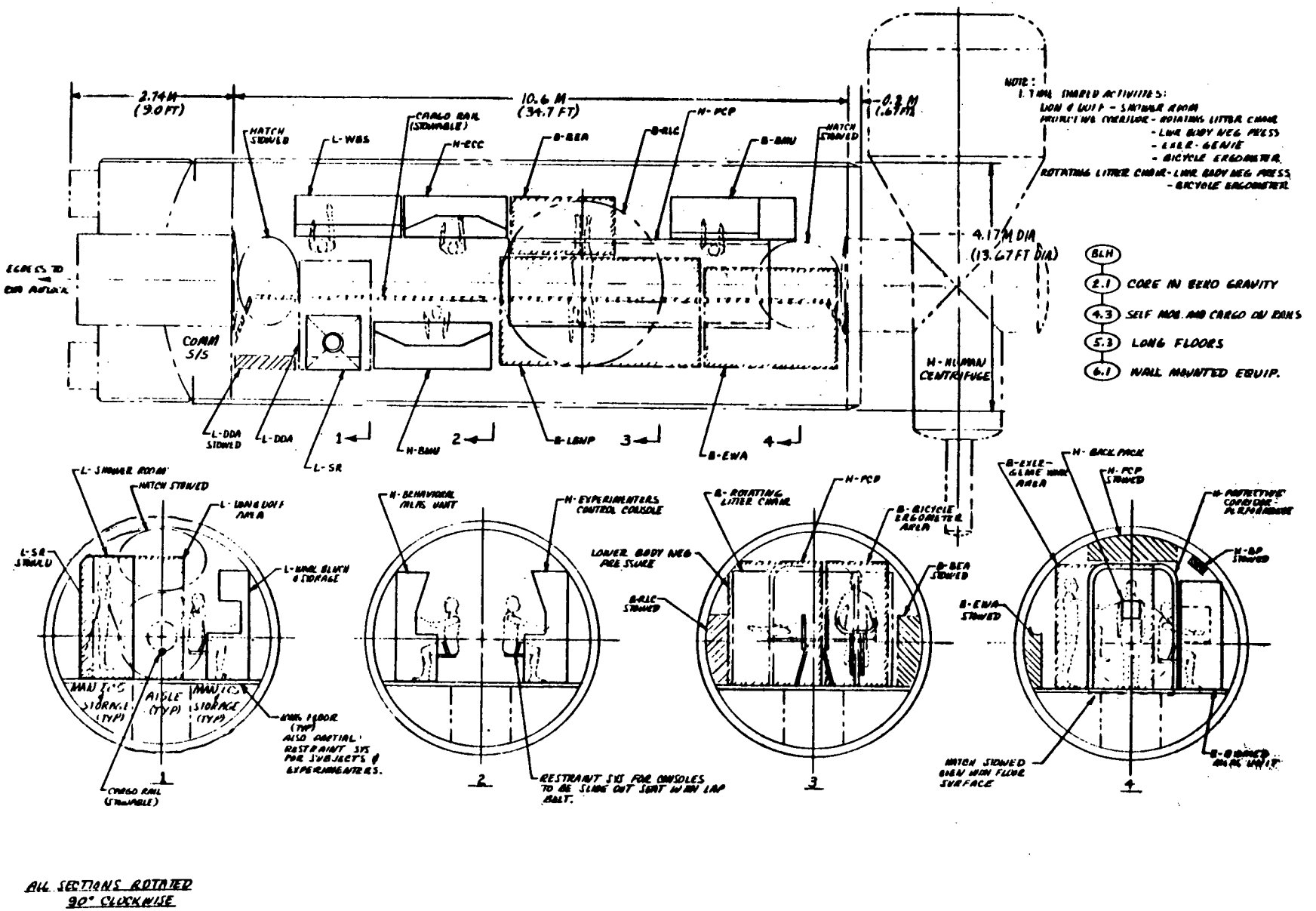
DES. CON. #	MODULE TYPE	SIZE OF MODULE REQUIRED: # OF MOD.	LENGTH (FT)	VOLUME[1] (FT³)	WEIGHT, LBS. X 1000: MOD. STRUCT.	INTERFACE STRUCT.	COMMON SUBSYS.	ECS	CONSUM.[2]	TOTAL[3]	SCIENTIFIC & SUPPORT EQUIPMENT PAYLOAD: VOLUME (FT³)	WEIGHT (LBS) X 1000	SCI. RES.	SHUTTLE LAUNCHES REQ'D: WEIGHT OF DEDICATED LAUNCHES	WEIGHT OF CARGO LAUNCHES	TOTAL # OF LNCHS	COSTS $ M: MODULE AND SUBSYS.	SCIENTIFIC & SUPPORT EQUIP. DEVEL.	SCIENTIFIC & SUPPORT EQUIP. UNIT	LAUNCH MOD.	LAUNCH CARGO	TOTAL	TOTAL FACILITY VOLUME[1] (FT³)	TOTAL FACILITY WEIGHT[3] (LBS) X 1000	ε_V[1]	% P/L[3]
2	F	1	48.3	4605	10.7	4.0	2.7	0.2 (CREW) 2.2 (EXP.)	1.1	20.9	784 9 80	16.3 0.1 (EU 3) 5.3 (EU 25-26)	100%	25.0	17.6	2.1	18.3	14.4 5.7 9.8	8.0 1.2 0.7	5.0	5.6	68.7	4605	42.6	0.19	0.51
	BLH	1	44.5	4152	10.2	1.5	2.7	0.7 (CREW)	0.1	15.2	179 106	2.2 1.1 (EU 11)	100%	18.5	—	1.0	17.6	7.1 0.3	7.1 0.2	5.0	—	37.3	4152	18.5	0.07	0.18
	FC	1	60.0	5364	10.1	3.0	3.1	0.2 (CREW) 2.9 (EXP)	1.5	20.8	336 535	7.0 10.2 (CORE-3)	100%	25.0	13.0	1.8	10.0	6.2 53.1	3.5 17.2	5.0	4.2	99.2	5364	38.0	0.16	0.45
	HC	1		2045						23.7	54	0.4	100%	24.1	—	1.0	153.4	1.2	0.2	5.0	—	159.8	2045	24.1	0.03	0.02
	TOTAL	4		16,166						80.6	2083	42.6	100%	92.6	30.6	5.9	199.3	97.8	38.1	20.0	9.8	365.0	16,166	123.2	0.13	0.35
2A	F	1		SAME AS CONCEPT 2										25.0	17.6	2.1	18.3	29.9	9.9	5.0	5.6	68.7				
	BLH	1		SAME AS CONCEPT 2										18.5	—	1.0	17.6	7.4	7.3	5.0	—	37.3				
	RC	1	60.0	5364	10.1	3.0	3.1	0.2 (CREW) 2.9 (EXP)	1.5	20.8	336 535	7.0 10.2 (CORE-3)	-HC/FC	25.0	13.0	1.8	153.4	6.2 53.1	3.5 17.2	5.0	4.2	242.6	5364	38.0	0.16	0.45
	TOTAL	3		14,121						56.9	2029	42.2	-HC/FC	68.5	30.6	4.9	189.3	96.6	37.9	15.0	9.8	348.6	14,121	99.1	0.14	0.43
2B	F	1	38.3	3412	9.4	3.2	2.7	0.2 (CREW) 2.2 (EXP)	1.1	18.8	784 9	16.3 0.1 (EU 3)	-EU25	25.0	10.2	1.7	17.8	14.4 5.7	8.0 1.2	5.0	3.3	55.4	3412	35.2	0.23	0.47
	BLH	1		SAME AS CONCEPT 2										18.5	—	1.0	17.6	7.4	7.3	5.0	—	37.3				
	RC	1		SAME AS CONCEPT 2A										25.0	13.0	1.8	153.4	59.3	20.7	5.0	4.2	242.6				
	TOTAL	3		12,928						54.8	1949	36.9	-HC/FC -EU25	68.5	28.2	4.5	188.8	86.8	37.2	15.0	7.5	335.3	12,928	91.7	0.15	0.40
2C	F	1	43.7	4056	10.1	3.5	2.7	0.2 (CREW) 2.2 (EXP)	1.1	19.8	607 9 80	13.4 0.1 (EU 3) 5.3 (EU 25-26)	-24 CM	25.0	13.5	1.9	17.9	14.4 5.7 9.8	7.8 1.2 0.7	5.0	4.3	66.8	4056	38.6	0.17	0.49
	BLH	1		SAME AS CONCEPT 2										18.5	—	1.0	17.6	7.4	7.3	5.0	—	37.3				
	RC	1		SAME AS CONCEPT 2A										25.0	13.0	1.8	153.4	59.3	20.7	5.0	4.2	242.6				
	TOTAL	3		13,572						55.8	1852	39.3	-HC/FC -24 CM	68.5	26.5	4.7	188.9	96.6	37.7	15.0	8.5	346.7	13,572	95.1	0.14	0.41
2D	F	1	32.7	2744	8.7	2.7	2.7	0.2 (CREW) 2.2 (EXP)	1.1	17.6	607 9	13.4 -24 CM 0.1 -EU25 (EU 3)		25.0	6.1	1.4	17.4	14.4 5.7	7.8 1.2	5.0	2.0	53.5	2744	31.1	0.22	0.43
	BLH	1		SAME AS CONCEPT 2										18.5	—	1.0	17.6	7.4	7.3	5.0	—	37.3				
	RC	1		SAME AS CONCEPT 2A										25.0	13.0	1.8	153.4	59.3	20.7	5.0	4.2	242.6				
	TOTAL	3		12,260						53.6	1772	34.0	-HC/FC -EU25 -24 CM	68.5	19.1	4.3	189.4	86.8	37.0	15.0	6.2	339.4	12,260	87.6	0.14	0.39

[1] BASED ON INSIDE USABLE DIAMETER. EXCLUDES COMMON SUBSYSTEMS COMPARTMENT.

[2] ASSUMES 90-DAY RESUPPLY

[3] EXCLUDES AIRLOCK

Figure I-24. Concept No. 2, Sheet 5



ALL SECTIONS ROTATED 90° CLOCKWISE

Figure I-25. Concept No. 3, BLH Module - Sheet 1

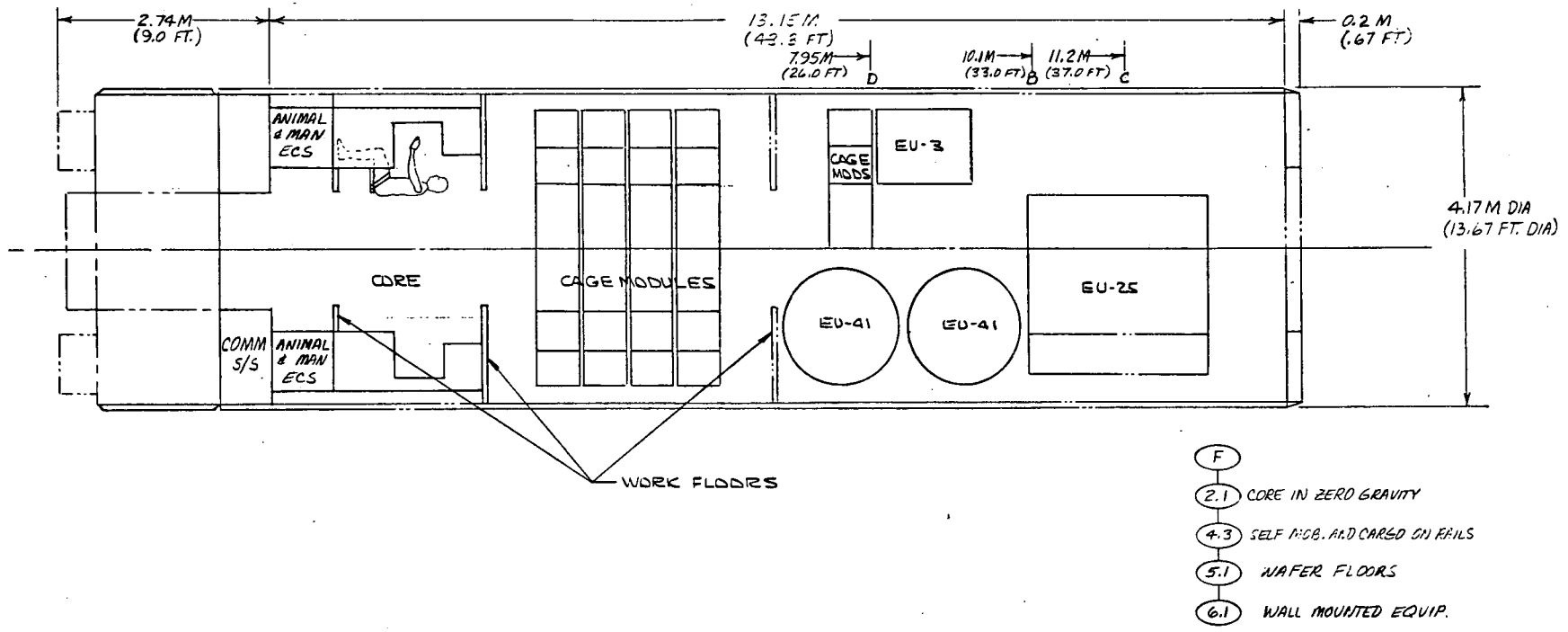
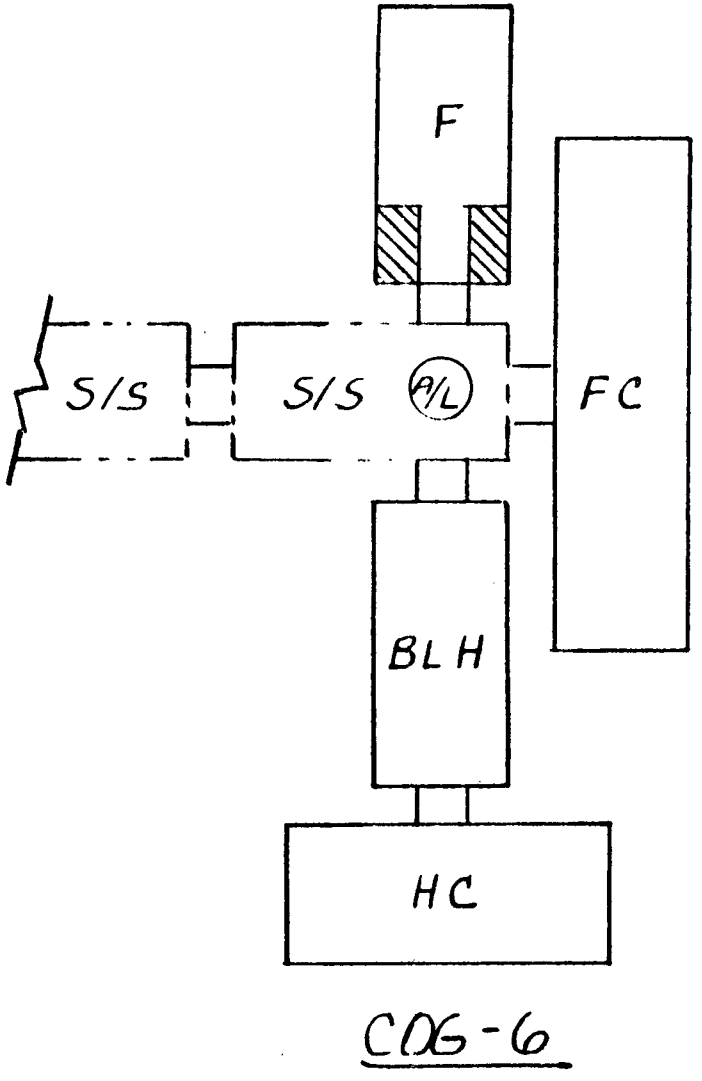
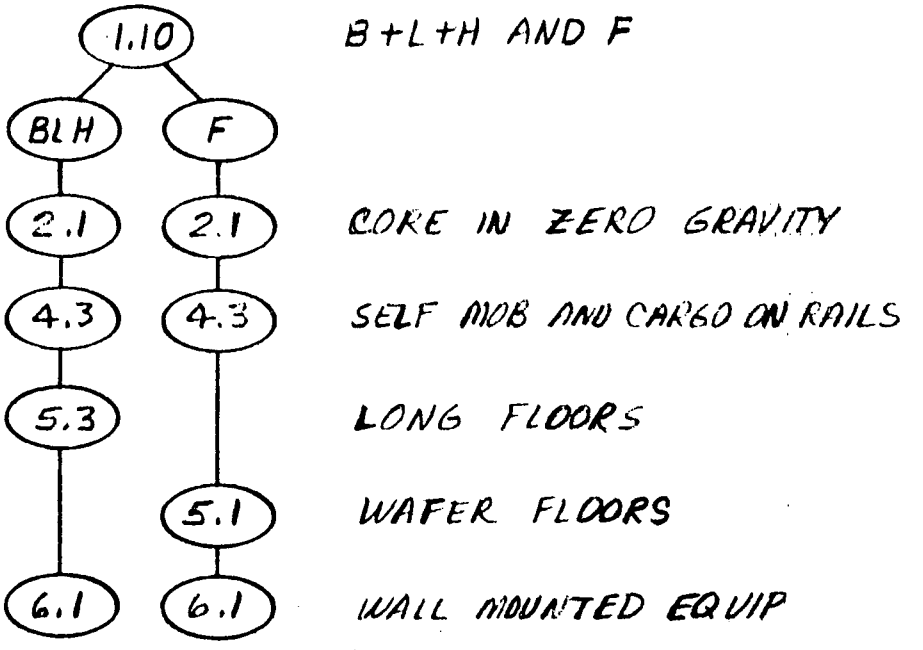


Figure I-25. Concept No. 3, F Module, Sheet 2





ALTERNATES:
COG-1
COG-2
COG-3
COG-4
COG-5
COG-7

Figure I-25. Concept No. 3, Module Cluster - Sheet 3

FIRST GENERATION CONCEPT NO. 3

DES. CON. #	MODULE TYPE	SIZE OF MODULE REQUIRED: # OF MOD.	LENGTH (FT)	VOLUME[1] (FT³)	WEIGHT, LBS. X 1000: MOD. STRUCT.	INTER-FACE STRUCT.	CONTR. SUBSYS.	ECS	CONSUM.[2]	TOTAL[3]	SCIENTIFIC & SUPPORT EQUIPMENT PAYLOAD: VOLUME (FT³)	WEIGHT (LBS) X 1000	SCI. RES.	SHUTTLE LAUNCHES REQ'D: WEIGHT OF DEDICATED LAUNCHES	WEIGHT OF CARGO LAUNCHES	TOTAL # OF LNCHS	COSTS ($ M): MODULE AND SUBSYS.	SCIENTIFIC & SUPPORT DEVEL.	SCIENTIFIC & SUPPORT EQUIP. UNIT	LAUNCH MOD.	LAUNCH CARGO	TOTAL	TOTAL FACILITY: VOLUME[1] (FT³)	TOTAL FACILITY: WEIGHT[3] (LBS) X 000	ε_v[1]	$\%$[3] P/L
3	F	1	53.5	5225	11.3	5.9	2.7	0.2 (CREW) 2.2 (EXP.)	1.1	23.4	784 544 80	16.3 10.3 (CORE) 5.3 (EU 25-26)	100%	25.0	30.3	2.9	18.5	14.4 58.8 9.8	8.0 18.4 0.7	5.0	9.7	183.3	5225	55.3	0.27	.58
	BLH	1	44.5	4152	10.2	1.5	2.7	0.7 (CREW)	0.1	15.2	179 106	2.2 1.1 (EU 11)	100%	18.5	—	1.0	17.6	7.1 0.3	7.1 0.2	5.0	—	37.3	4152	18.5	0.07	.18
	FC	1	60.0	5364	10.1	1.5	3.1	0.2 2.9	1.5	19.3	336	7.0	100%	25.0	1.3	1.1	10.0	6.2	3.5	5.0	.4	25.1	5364	26.3	0.06	.27
	HC	1	-	2045	-	—	—	—	—	23.7	54	0.4	100%	34.1	—	1.0	153.4	1.2	0.2	5.0	—	159.8	2045	24.1	0.03	.02
	TOTAL	4	—	16,786						81.6	2083	42.6	100%	98.6	31.6	6.0	199.5	97.8	38.1	20.0	10.1	365.5	16,786	124.2	0.12	.34
3A	F	1		SAME AS CONCEPT 3										25.0	30.3	2.9	18.5	83.0	27.1	5.0	9.7	143.3				
	BLH	1		SAME AS CONCEPT 3										18.5	—	1.0	17.6	7.4	7.3	5.0	—	37.3				
	RC	1	60.0	5364	10.1	1.5	3.1	0.2 2.9	1.5	19.3	336	7.0	-HC/R	25.0	1.3	1.1	153.4	6.2	3.5	5.0	.4	168.5	5364	26.3	0.06	.27
	TOTAL	3		14,741						57.9	2029	42.2	-HC/FC	68.5	31.6	5.0	189.5	96.6	37.9	15.0	10.1	348.1	14,741	100.1	0.14	.42
3B	F	1	42.5	3936	10.0	5.1	2.7	0.2 (CREW) 2.2 (EXP)	1.1	21.3	784 544	16.3 10.3 (CORE)	-EU25	25.0	22.9	2.5	18.3	14.4 58.8	8.0 18.4	5.0	7.3	130.2	3936	47.9	0.34	.56
	BLH	1		SAME AS CONCEPT 3										18.5	—	1.0	17.6	7.4	7.3	5.0	—	37.3				
	RC	1		SAME AS CONCEPT 3A										25.0	1.3	1.1	153.4	6.2	3.5	5.0	.4	168.5				
	TOTAL	3		13,452						55.8	1949	36.9	-HC/R -EU25	68.5	34.2	4.6	189.3	86.8	37.2	15.0	7.7	336.0	13,452	92.7	0.14	.40
3C	F	1	46.5	4414	10.5	5.5	2.7	0.2 (CREW) 2.2 (EXP)	1.1	22.2	607 544 80	13.4 10.3 (CORE) 5.3 (EU 25-26)	-24CM	25.0	26.2	2.7	18.4	14.4 58.8 9.8	7.8 18.4 0.7	5.0	8.4	141.7	4414	51.2	0.28	0.57
	BLH	1		SAME AS CONCEPT 3										18.5	—	1.0	17.6	7.4	7.3	5.0	—	37.3				
	RC	1		SAME AS CONCEPT 3A										25.0	1.3	1.1	153.4	6.2	3.5	5.0	.4	168.5				
	TOTAL	3		13,930						56.7	1852	39.3	-HC/R -24CM	68.5	27.5	4.8	189.4	96.6	37.7	15.0	8.8	347.5	13,930	96.0	0.13	.41
3D	F	1	35.5	3102	9.1	4.7	2.7	0.2 (CREW) 2.2 (EXP)	1.1	20.0	607 -549	13.4 -0.3 (CORE)	-24CM -EU25	25.0	18.7	2.2	18.0	14.4 58.8	7.8 18.4	5.0	6.0	129.4	3102	43.7	0.37	.54
	BLH	1		SAME AS CONCEPT 3										18.5	—	1.0	17.6	7.4	7.3	5.0	—	37.3				
	RC	1		SAME AS CONCEPT 3A										25.0	1.3	1.1	153.4	6.2	3.5	5.0	.4	168.5				
	TOTAL	3		12618						54.5	1772	34.0	-HC/R -EU25	68.5	20.0	4.3	189.0	86.8	37.0	15.0	6.4	334.0	12618	88.5	0.14	.38

[1] BASED ON INSIDE USABLE DIAMETER. EXCLUDES COMMON SUBSYSTEMS COMPARTMENT. AIRLOCK

[2] ASSUMES 90-DAY RESUPPLY

[3] EXCLUDES AIRLOCK WEIGHT

Figure I-25. Concept No. 3, Sheet 4

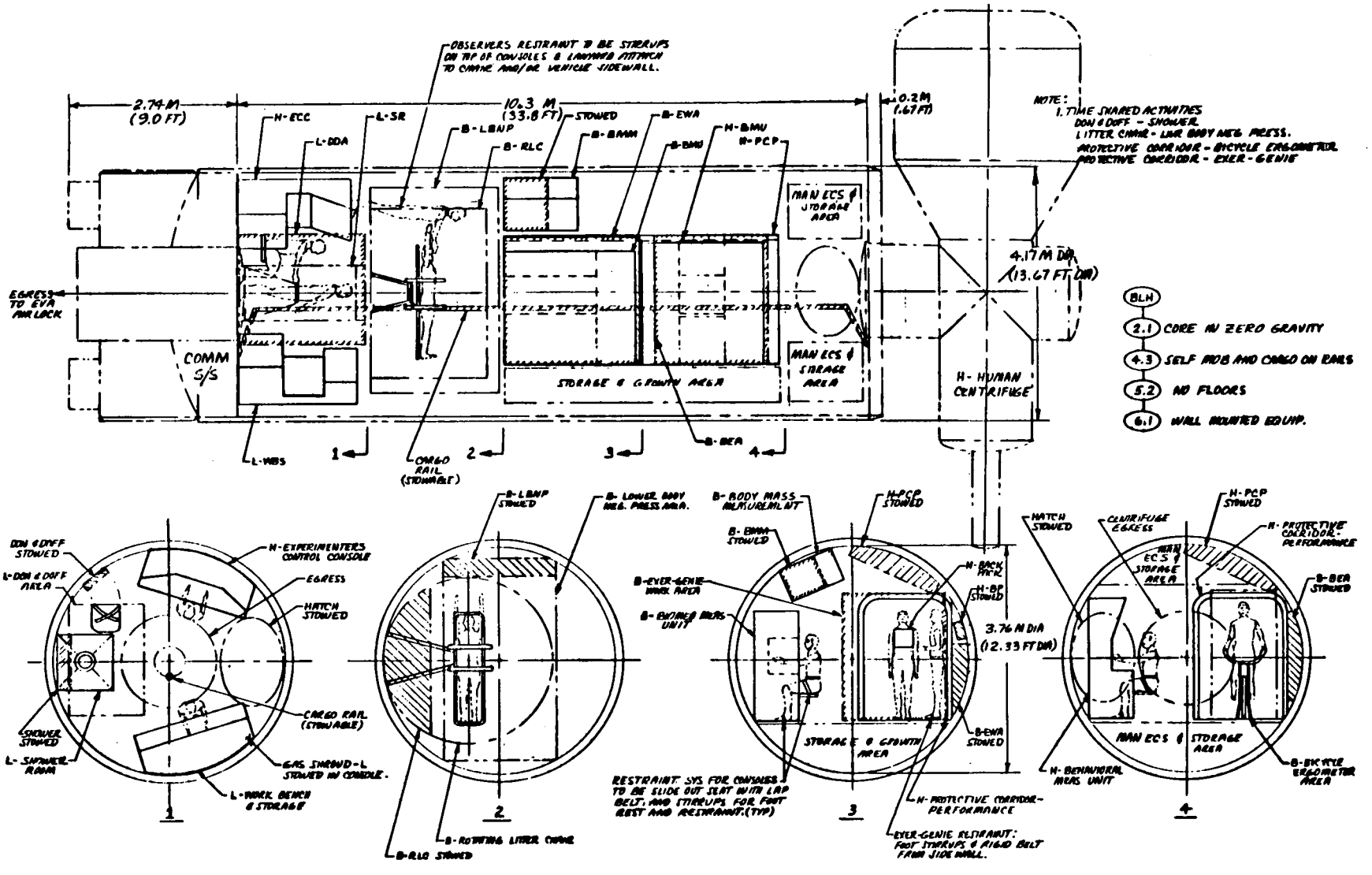
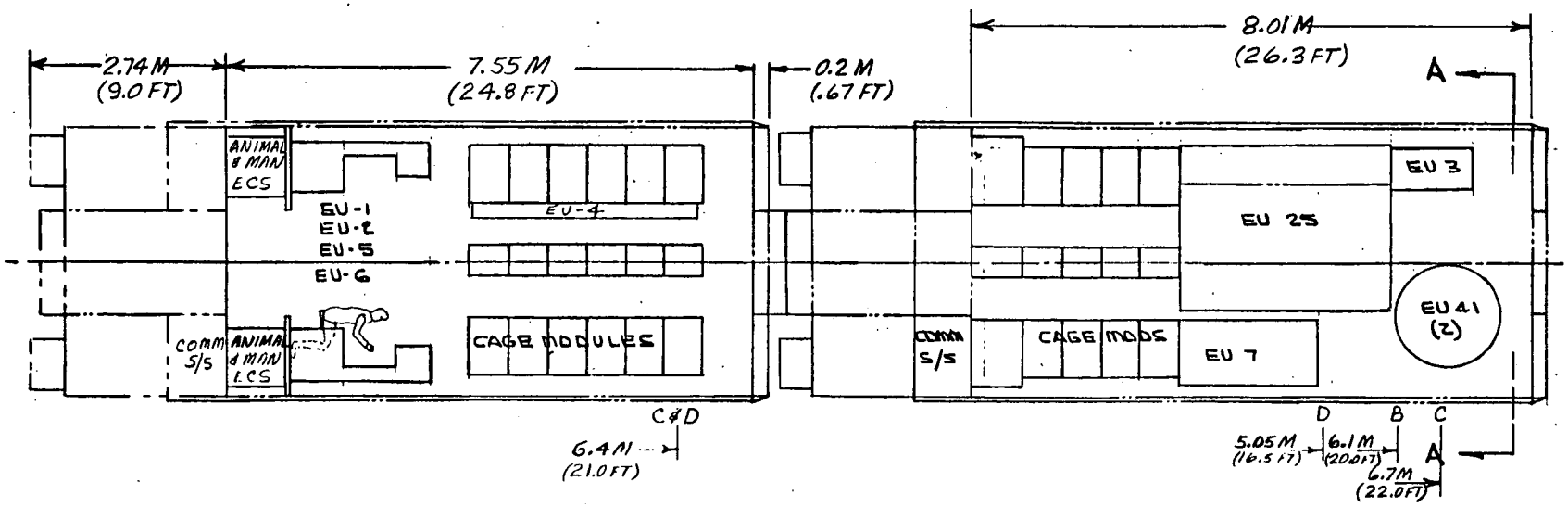


Figure I-26. Concept No. 4, BLH Module - Sheet 1



F
2.1 CORE IN ZERO GRAVITY
4.3 SELF MOB. AND CARGO ON RAILS
5.2 NO FLOORS
6.1 WALL MOUNTED EQUIP.

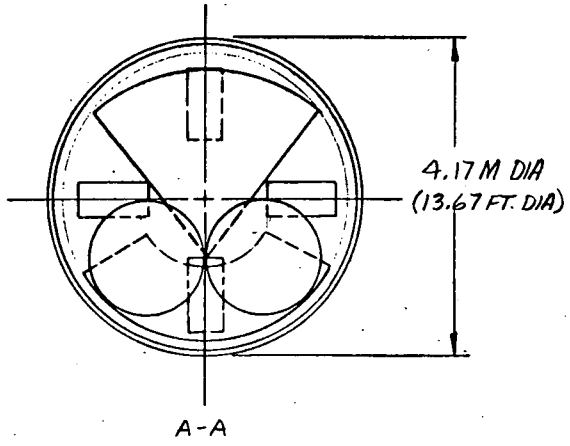
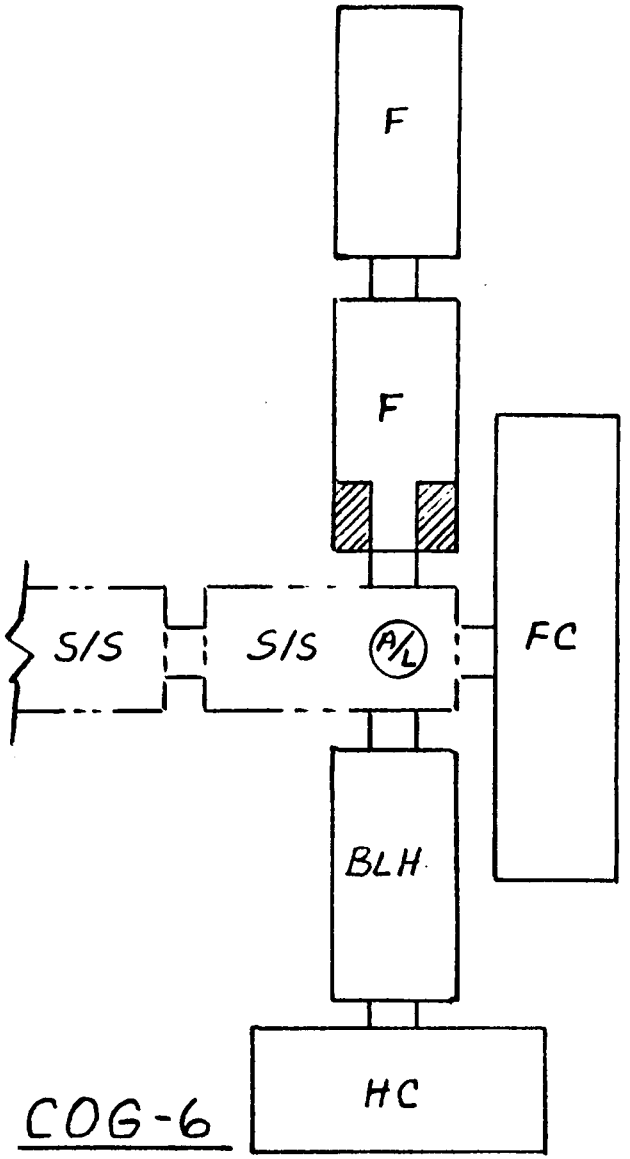
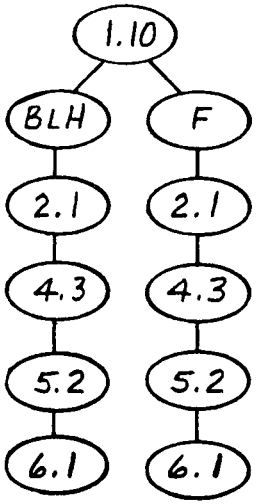


Figure I-26. Concept No. 4, F Module - Sheet 2





B+L+H AND F

CORE IN ZERO GRAVITY

SELF MOB AND CARGO ON RAILS

NO FLOORS

WALL MOUNTED EQUIP.

ALTERNATES:
COG-4
COG-5

Figure I-26. Concept No. 4, Module Cluster - Sheet 3

FIRST GENERATION CONCEPT NO. 4

DES. CON. #	MODULE TYPE	SIZE OF MODULE REQUIRED: # OF MOD.	LENGTH (FT)	VOLUME[1] (FT^3)	WEIGHT, LBS. X 1000: MOD. STRUCT.	INTERFACE STRUCT.	COMMON SUBSYS.	ECS	CONSUM.[2]	TOTAL[3]	SCIENTIFIC & SUPPORT EQUIPMENT PAYLOAD: VOLUME (FT^3)	WEIGHT (LBS) X 1000	SCI. RES.	SHUTTLE LAUNCHES REQ'D: WEIGHT OF DEDICATED LAUNCHES	WEIGHT OF CARGO LAUNCHES	TOTAL # OF DED. LNCH.	COSTS: MODULE AND SUBSYS.	SCIENTIFIC & SUPPORT EQUIP. DEVEL.	SCIENTIFIC & SUPPORT EQUIP. UNIT	LAUNCH MOD.	LAUNCH CARGO	COSTS TOTAL	TOTAL FACILITY VOLUME[1] (FT^3)	TOTAL FACILITY WEIGHT[3] (LBS) X 1000	ϵ_v[1]	$\%_c$[3] P/L
4	F	2	35.9	3138	9.1	2.7	2.7	0.1 (CREW) 1.1 (EXP.)	0.6	16.3	392 529	8.2 10.1 (CORE)	100%	25.0	9.6	1.6	17.6	7.2 53.1	4.0 17.2	5.0	3.1	107.2	3138	34.6	0.29	0.53
			34.5	2959	8.9	2.0	2.7	0.1 (CREW) 1.1 (EXP.)	0.5	15.3	392 15 80	8.1 0.2 (CORE) 5.3 (EU 23-36)	100%	25.0	3.9	1.3	17.3	7.2 5.7 9.8	4.0 1.2 0.7	5.0	1.2	52.1	2959	28.9	0.16	0.47
	BLH	1	43.7	4056	10.1	0.5	2.7	0.7 (CREW)	0.1	14.1	179 106	2.2 1.1 (EU 11)	100%	17.4	—	1.0	17.3	7.1 0.3	7.1 0.2	5.0	—	37.0	4056	17.4	0.07	0.19
	FC	1	60.0	5364	10.1	1.5	3.1	0.4 2.4	1.5	19.3	336	7.0	100%	25.0	1.3	1.1	10.0	6.2	3.5	5.0	.4	25.1	5364	26.3	0.06	0.27
	HC	1		2045						23.7	54	0.4	100%	24.1	—	1.0	153.4	1.2	0.2	5.0	—	159.8	2045	24.1	0.03	0.02
	TOTAL	5		17,562						88.7	2083	42.6	100%	116.5	14.8	6.0	215.6	97.8	38.1	25.0	4.7	381.2	17,562	131.3	0.12	0.32
4A	F	2			SAME AS CONCEPT 4									25.0	9.6	1.6	17.6	60.3	21.2	5.0	3.1	107.2				
					SAME AS CONCEPT 4									25.0	3.9	1.3	17.3	22.7	5.9	5.0	1.2	52.1				
	BLH	1			SAME AS CONCEPT 4									17.4	—	1.0	17.3	7.4	7.3	5.0	—	37.0				
	RC	1	60.0	5364	10.1	1.5	3.1	0.4 2.4	1.8	19.3	336	7.0	HC/FC	25.0	1.3	1.1	153.4	6.2	3.5	5.0	.4	164.5	5364	26.3	0.06	0.27
	TOTAL	4		15,517						65.0	2029	42.2	HC/FC	92.4	14.8	5.0	205.6	96.6	37.9	20.0	4.7	364.8	15,517	107.2	0.13	0.39
4B	F	2			SAME AS CONCEPT 4									25.0	9.6	1.6	17.6	60.3	21.2	5.0	3.1	107.2				
			29.7	2386	8.3	1.2	2.7	0.1 (CREW) 1.1 (EXP.)	0.5	13.9	392 15	8.1 0.2 (CORE)	EU 25	29.2	—	1.0	17.1	7.2 5.7	4.0 1.2	5.0	—	40.2	2386	22.2	0.17	0.37
	BLH	1			SAME AS CONCEPT 4									17.4	—	1.0	17.3	7.4	7.3	5.0	—	37.0				
	RC	1			SAME AS CONCEPT 4A									25.0	1.3	1.1	153.4	6.2	3.5	5.0	.4	168.5				
	TOTAL	4		14,944						63.6	1949	36.9	EU 25	89.6	10.9	4.7	205.4	86.8	37.2	20.0	3.5	352.9	14,944	100.5	0.13	0.37
4C	F	2	30.7	2505	8.5	2.5	2.7	0.1 (CREW) 1.1 (EXP.)	0.6	15.5	304 529	6.7 10.1 (CORE)	12CM	25.0	7.3	1.5	17.3	7.2 53.1	3.9 17.2	5.0	2.3	106.0	2505	32.3	0.33	0.52
			31.7	2625	8.6	1.8	2.7	0.1 (CREW) 1.1 (EXP.)	0.5	14.8	303 15	6.7 0.2 (CORE) 5.3 (EU 23-36)	12CM	21.7	—	1.0	17.2	7.2 5.7 9.8	3.9 1.2 0.7	5.0	—	50.7	2625	27.0	0.12	0.45
	BLH	1			SAME AS CONCEPT 4									17.4	—	1.0	17.3	7.4	7.3	5.0	—	37.0				
	RC	1			SAME AS CONCEPT 4A									25.0	1.3	1.1	153.4	6.2	3.5	5.0	.4	168.5				
	TOTAL	4		14,550						63.7	1852	39.3	HC/FC 24CM	69.1	8.6	4.6	205.2	96.6	37.7	20.0	2.7	362.2	14,550	103.0	0.13	0.38
4D	F	2	30.7	2505	8.5	2.5	2.7	0.1 (CREW) 1.1 (EXP.)	0.6	15.5	304 529	6.7 10.1 (CORE)	12CM	25.0	7.3	1.5	17.3	7.2 53.1	3.9 17.2	5.0	2.3	106.0	2505	32.3	0.33	0.52
			26.2	1968	7.9	1.0	2.7	0.1 (CREW) 1.1 (EXP.)	0.5	13.3	303 15	6.7 0.2 (CORE)	12CM EU 25	20.2	—	1.0	17.0	7.2 5.7	3.9 1.2	5.0	—	40.0	1968	20.2	0.16	0.34
	BLH	1			SAME AS CONCEPT 4									17.4	—	1.0	17.3	7.4	7.3	5.0	—	37.0				
	RC	1			SAME AS CONCEPT 4A									25.0	1.3	1.1	153.4	6.2	3.5	5.0	.4	168.5				
	TOTAL	4		13,893						62.2	1772	34.0	HC/FC 24CM	67.6	8.6	4.6	205.0	86.8	37.0	20.0	2.7	352.5	13,893	96.2	0.13	0.35

[1] BASED ON INSIDE USABLE DIAMETER. EXCLUDES COMMON SUBSYSTEMS COMPARTMENT. AIRLOCK

[2] ASSUMES 90-DAY RESUPPLY

[3] EXCLUDES AIRLOCK WEIGHT

Figure I-26. Concept No. 4, Sheet 4

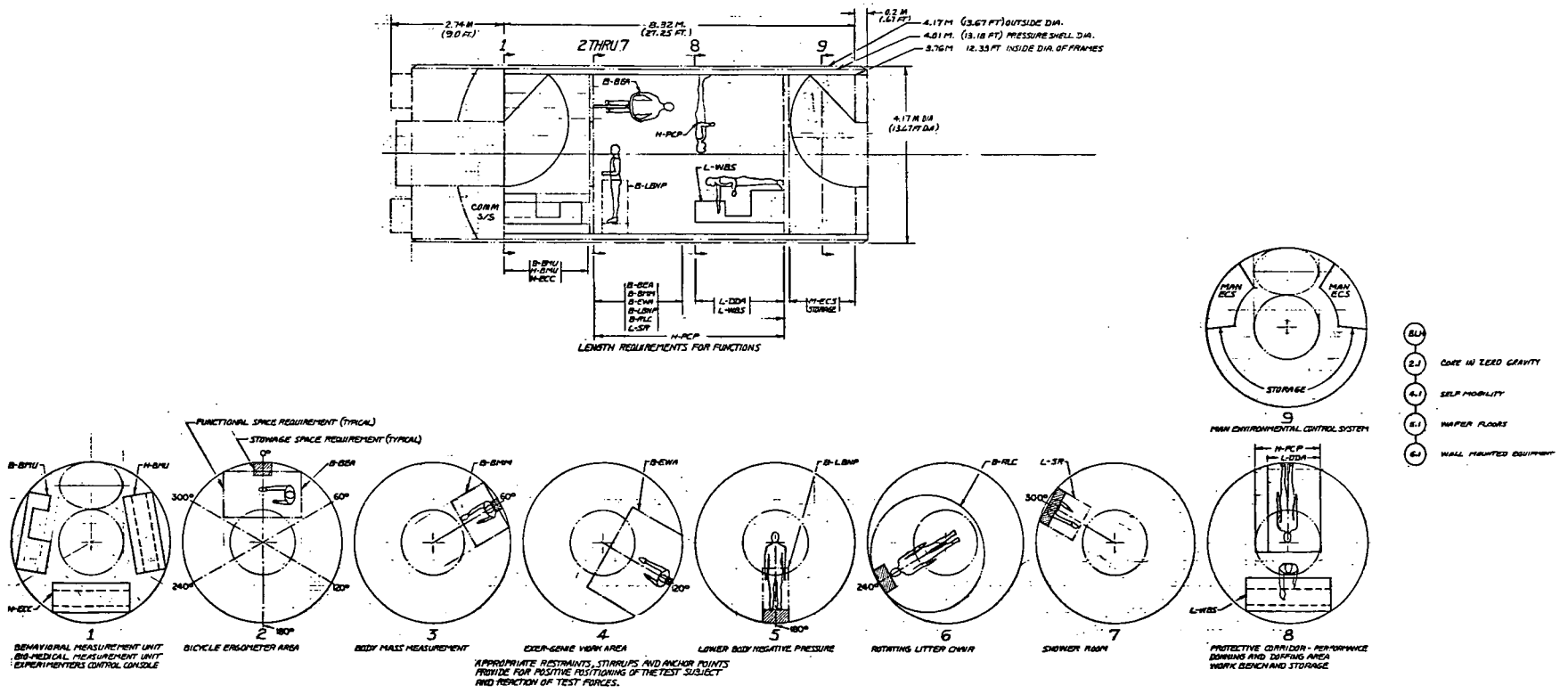


Figure I-27. Concept No. 5, BLH Module - Sheet 1

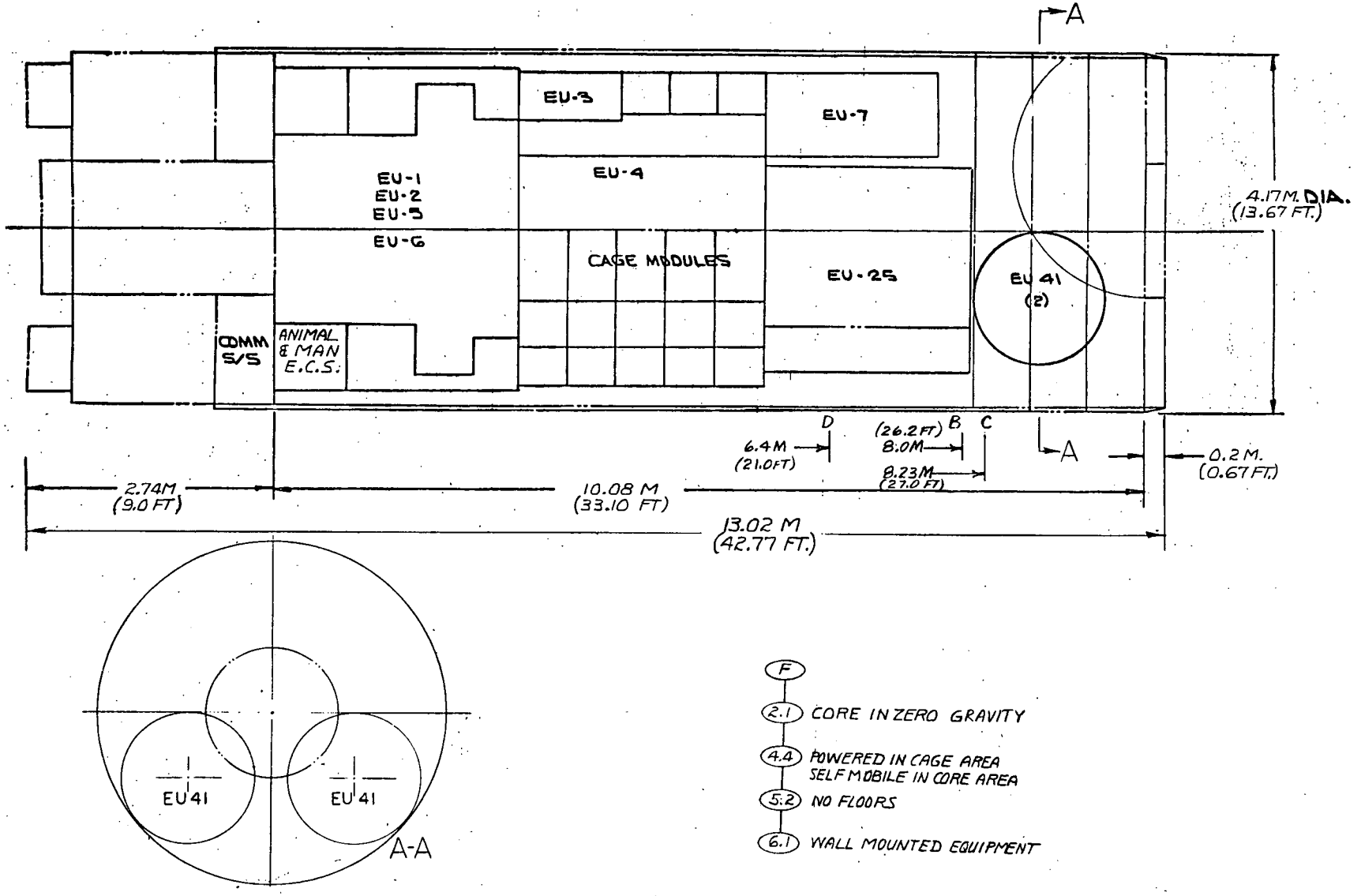


Figure I-27. Concept No. 5, F Module - Sheet 2

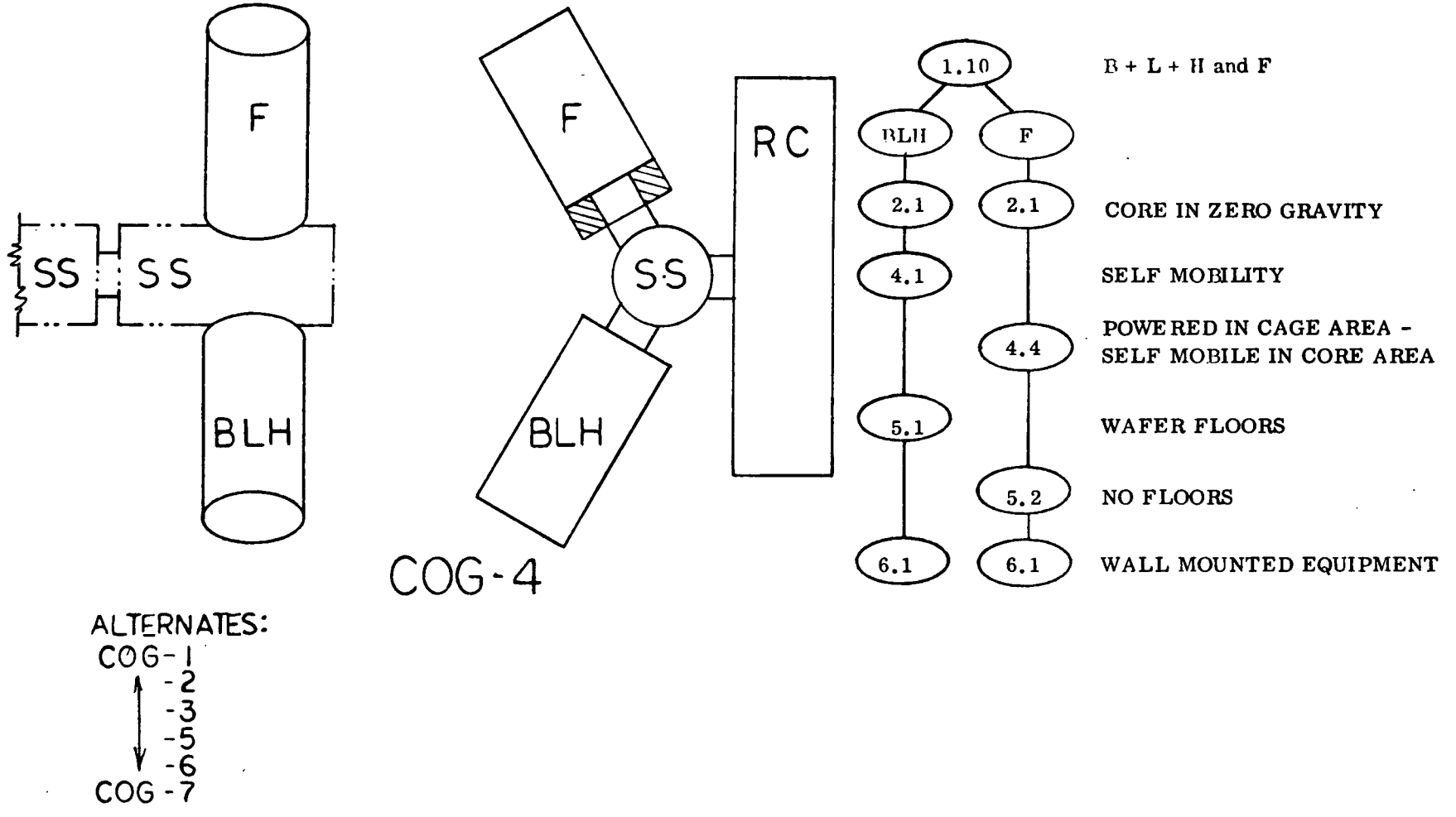


Figure I-27. Concept No. 5, Module Cluster - Sheet 3

FIRST GENERATION CONCEPT NO. 5

DES. CONF. #	MODULE TYPE	# OF MOD.	LENGTH (FT)	VOLUME[1] (FT³)	WEIGHT, LBS. X 1000 MOD. STRUCT.	INTER-FACE STRUCT.	COMMON SUBSYS.	ECS	CONSUM.[2]	TOTAL[3]	SCIENTIFIC & SUPPORT EQUIPMENT PAYLOAD VOLUME (FT³)	WEIGHT (LBS) X 1000	SCI. RES.	SHUTTLE LAUNCHES REQ'D WEIGHT OF DEDICATED LAUNCHES	WEIGHT OF CARGO LAUNCHES	TOTAL # OF LNCHS	COSTS MODULE AND SUBSYS.	SCIENTIFIC & SUPPORT EQUIP. DEVEL.	SCIENTIFIC & SUPPORT EQUIP. UNIT	LAUNCH MOD.	LAUNCH CARGO	TOTAL	TOTAL FACILITY VOLUME[1] (FT³)	TOTAL FACILITY WEIGHT[3] (LBS) X1000	E_v	% P/L
5	F	1	42.8	3901	10.0	1.8	2.7	0.2 (CRIW) 2.2 (EXP)	1.1	21.0	784 5.1.1 80	16.3 10.3 (CORE) 5.3 (EU 25-26)	100%	25.0	27.9	2.8	18.3	14.4 58.8 9.8	8.0 18.4 0.7	5.0	8.9	142.3	3901	52.9	0.36	0.60
	BLH	1	37.0	3257	9.2	1.2	2.7	0.1 (CREW)	0.1	13.9	179 106	2.2 1.1 (EU 11)	100%	17.2	—	1.0	17.2	7.1 0.3	7.1 0.2	5.0	—	36.9	3257	17.2	0.09	0.19
	FC	1	60.0	5364	10.1	1.5	3.1	0.2 0.9	1.5	19.3	336	7.0	100%	25.0	1.3	1.1	10.0	6.2	3.5	5.0	.4	25.1	5364	26.3	0.06	0.27
	HC			2045						23.7	54	0.4	100%	24.1	—	1.0	153.4	1.2	0.2	5.0	—	159.8	2045	24.1	0.03	0.02
	TOTAL			14,567						77.9	2083	42.6	100%	91.3	29.2	5.9	198.9	97.8	38.1	20.0	9.3	364.1	14,567	120.5	0.14	0.35
5A	F	1			SAME AS CONCEPT 5									25.0	27.9	2.8	18.3	83.0	27.1	5.0	8.9	142.3				
	BLH	1			SAME AS CONCEPT 5									17.2	—	1.0	17.2	7.4	7.3	5.0	—	36.9				
	RC	1	60.0	5364	10.1	1.5	3.1	0.2 0.9	1.5	19.3	336	7.0	-HC/FC	25.0	1.3	1.1	153.4	6.2	3.5	5.0	.4	168.5	5364	26.3	0.06	0.27
	TOTAL	3		12,522						54.2	2029	42.2	-HC/FC	67.2	29.2	4.9	188.9	96.6	37.9	15.0	9.3	347.7	12,522	96.4	0.16	0.44
5B	F	1	35.9	3126	9.1	4.0	2.7	0.2 (CREW) 2.2 (EXP)	1.1	19.3	784 544	16.3 10.3 (CORE)	-EU 25	25.0	20.9	2.3	17.8	14.4 58.8	8.0 18.4	5.0	6.7	129.1	3126	45.9	0.42	0.58
	BLH	1			SAME AS CONCEPT 5									17.2	—	1.0	17.2	7.4	7.3	5.0	—	36.9				
	RC	1			SAME AS CONCEPT 5A									25.0	1.3	1.1	153.4	6.2	3.5	5.0	.4	168.5				
	TOTAL	3		11,747						52.5	1949	36.9	-HC/FC -EU 25	67.2	22.3	4.4	188.4	86.8	37.2	15.0	7.1	334.5	11,747	89.4	0.17	0.41
5C	F	1	36.7	3221	9.2	4.4	2.7	0.2 (CREW) 2.2 (EXP)	1.1	19.8	607 544 80	13.4 10.3 (CORE) 5.3 (EU 25-26)	-24 CM	25.0	18.5	2.2	17.9	14.4 58.8 9.8	7.8 18.4 0.7	5.0	5.9	138.7	3221	48.8	0.38	0.59
	BLH	1			SAME AS CONCEPT 5									17.2	—	1.0	17.2	7.4	7.3	5.0	—	36.9				
	RC	1			SAME AS CONCEPT 5A									25.0	1.3	1.1	153.4	6.2	3.5	5.0	.4	168.5				
	TOTAL	3		11,842						53.0	1852	39.3	-HC/FC -24 CM	67.2	19.8	4.3	188.5	96.6	37.7	15.0	6.3	344.1	11,842	92.3	0.16	0.43
5D	F	1	30.7	2505	8.5	3.6	2.7	0.2 (CREW) 2.2 (EXP)	1.1	18.3	607 544	13.4 10.3 (CORE)	-24 CM -EU 25	25.0	17.0	2.1	17.5	14.4 58.8	7.8 18.4	5.0	5.4	127.3	2505	42.0	0.46	0.56
	BLH	1			SAME AS CONCEPT 5									17.2	—	1.0	17.2	7.4	7.3	5.0	—	36.9				
	RC	1			SAME AS CONCEPT 5A									25.0	1.3	1.1	153.4	6.2	3.5	5.0	.4	168.5				
	TOTAL	3		11,126						51.5	1772	34.0	-HC/FC -EU 25 -24 CM	67.2	18.3	4.2	188.1	86.8	37.0	15.0	5.8	332.7	11,126	85.5	0.16	0.40

[1] BASED ON INSIDE USABLE DIAMETER. EXCLUDES COMMON SUBSYSTEMS COMPARTMENT. AIRLOCK

[2] ASSUMES 90-DAY RESUPPLY

[3] EXCLUDES AIRLOCK WEIGHT

Figure I-27. Concept No. 5, Sheet 4

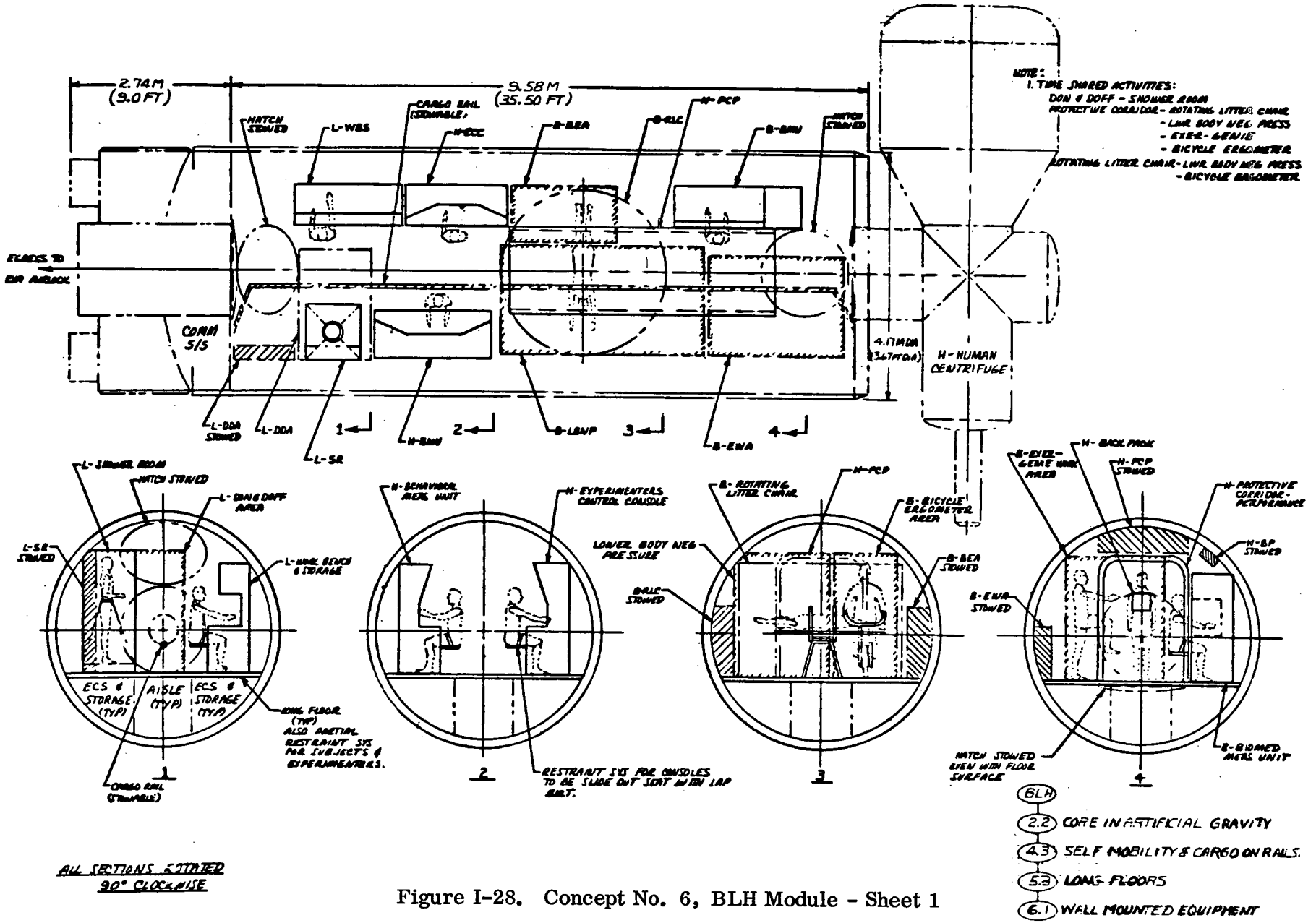


Figure I-28. Concept No. 6, BLH Module - Sheet 1

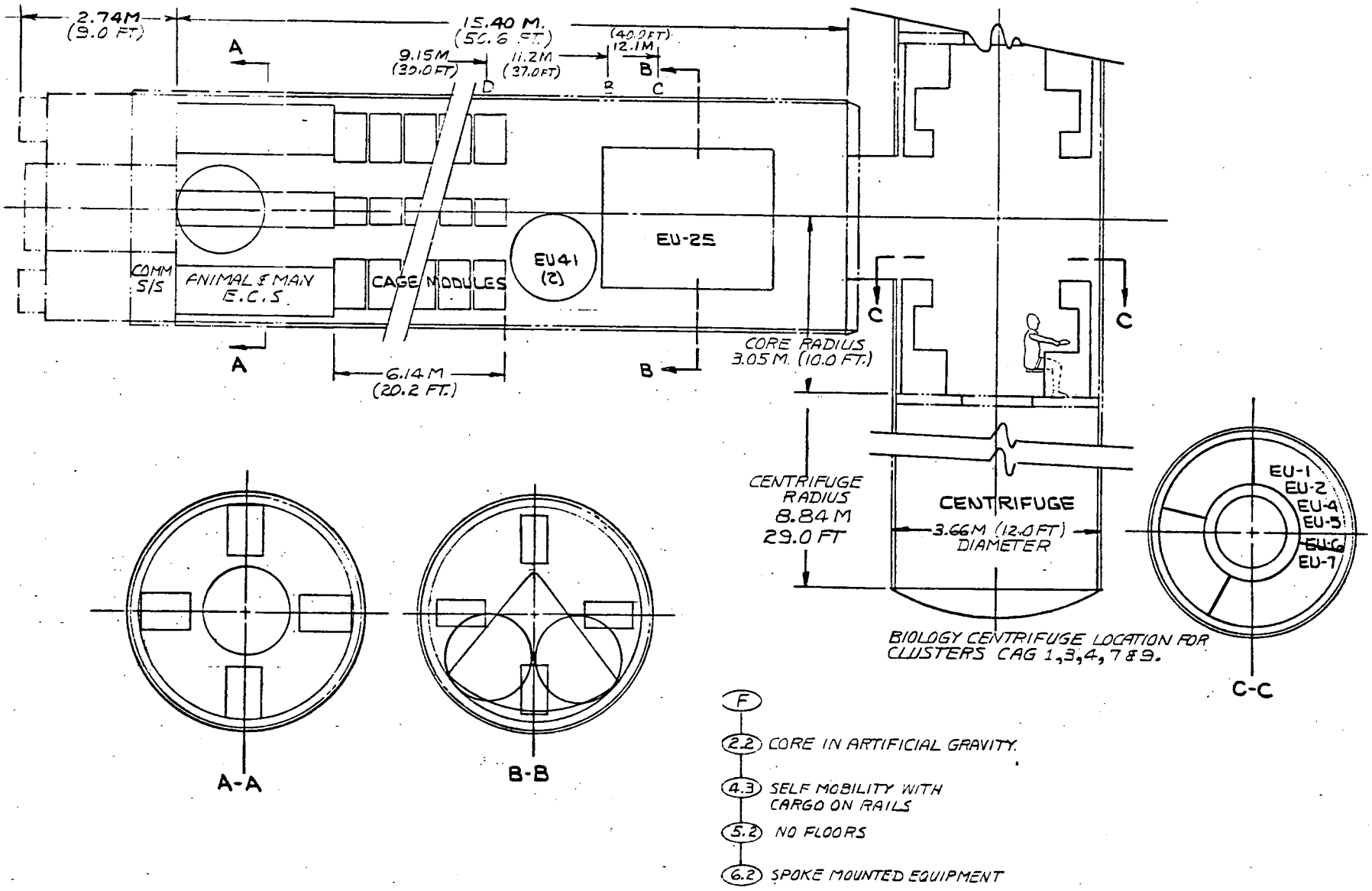


Figure I-28. Concept No. 6, F Module - Sheet 2

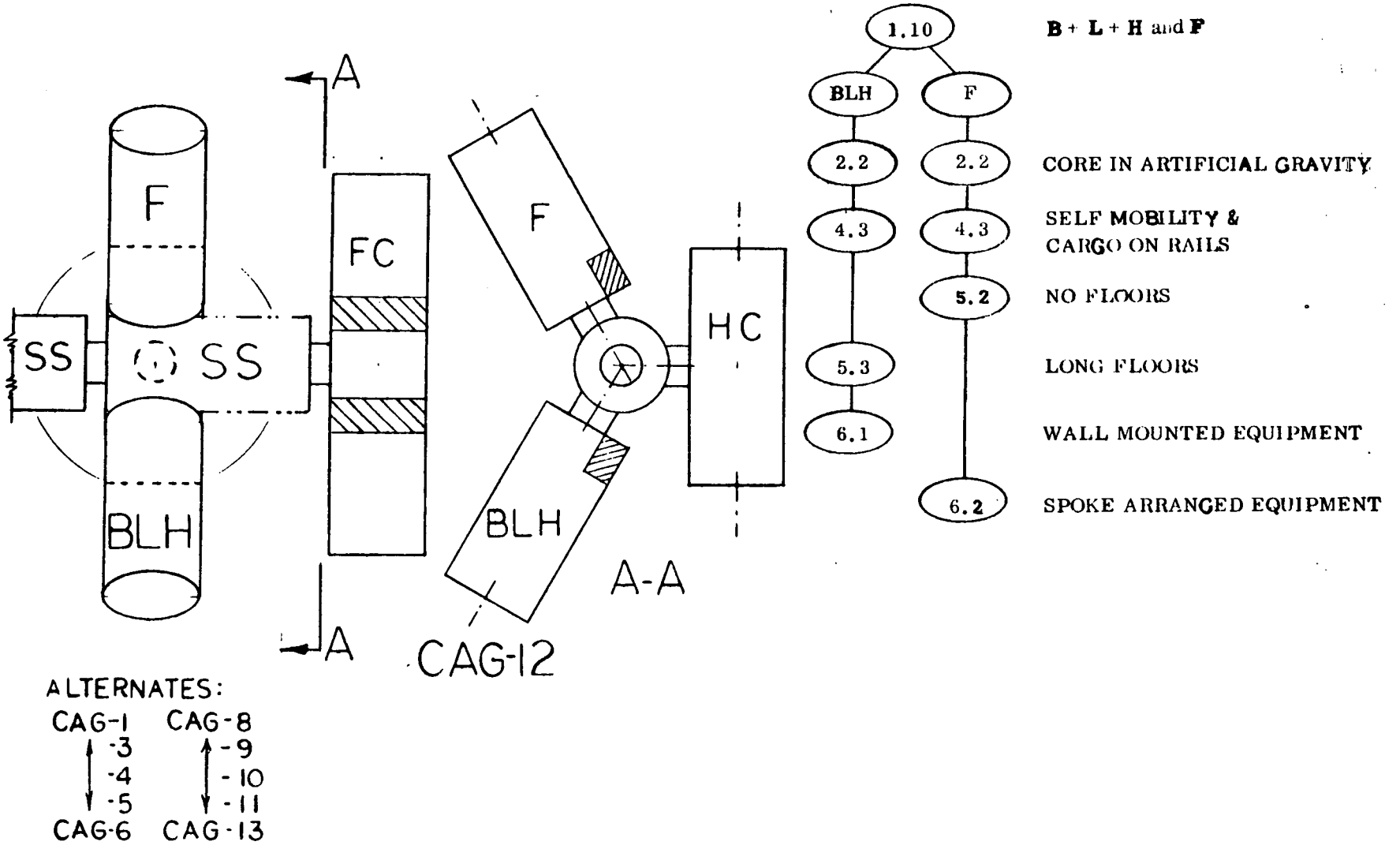


Figure I-28. Concept No. 6, Module Cluster - Sheet 3

FIRST GENERATION CONCEPT NO. 6

DES. CON. #	MODULE TYPE	SIZE OF MODULE REQ'D: # OF MODS.	LENGTH (FT)	VOLUME[1] (FT³)	WEIGHT, LBS. X 000: MOD. STRUCT.	INTERFACE STRUCT.	COMM. SUBSYS.	ECS	CONT. SYS.[2]	TOTAL[3]	SCIENTIFIC & SUPPORT EQUIPMENT PAYLOAD: VOLUME (FT³)	WEIGHT (LBS) X 1000	SCI. REQ.	WEIGHT OF DEDICATED LAUNCHES	WEIGHT OF CARGO LAUNCHES	SHUTTLE LAUNCHES REQ'D: TOTAL # OF LNCH'S	MODULE AND SUBSYS.	COSTS: SCIENTIFIC & SUPPORT EQUIP. DEV.	DEV. UNIT	LAUNCH MOD.	LAUNCH CARGO	TOTAL	TOTAL FACILITY VOLUME[1] (FT³)	TOTAL FACILITY WEIGHT[3] (LBS) X 1000	E_V'	% P/L
6	F	1	60.3	6037	12.2	3.3	2.7	0.2 (CREW) 2.2 (EXP)	1.1	21.7	784 9 80	16.3 0.1 (EU 3) 5.3 (EU 25-26)	100%	25.0	18.4	2.2	18.3	9.8	4.4 5.7 0.7	8.0 1.2	5.0	5.9	69.0	6037	43.4	0.14	0.50
	BLH	1	44.5	4152	10.2	1.5	2.7	0.7 (CREW)	0.1	15.2	179 106	2.2 1.1 (EU 11)	100%	18.5	—	1.0	17.6	0.3	7.1	7.1 0.2	5.0	—	37.3	4152	18.5	0.07	0.18
	FC	1	60.0	5364	10.1	3.0	3.1	0.2 (CREW) 2.9 (EXP)	1.5	20.8	336 535	7.0 10.2 (CORE-3)	100%	25.0	13.0	1.8	10.0	53.1	6.2	3.5 17.2	5.0	4.2	98.2	5364	38.0	0.16	0.45
	HC	1		2045						23.7	54	0.4	100%	24.1	—	1.0	153.4	1.2		0.2	5.0	—	159.8	2045	24.1	0.03	0.02
	TOTAL	4		17,598						81.4	2083	42.6	100%	92.6	31.4	6.0	199.3	97.8		38.1	20.0	10.1	365.3	17,598	124.0	0.12	0.34
6A	F	1			SAME AS CONCEPT 6									25.0	18.4	2.2	18.3	29.9		9.9	5.0	5.9	69.0				
	BLH	1			SAME AS CONCEPT 6									18.5	—	1.0	17.6	7.4		7.3	5.0	—	37.3				
	RC	1	60.0	5364	10.1	3.0	3.1	0.2 (CREW) 2.9 (EXP)	1.5	20.8	336 535	7.0 10.2 (CORE-3)	HC/FC	25.0	13.0	1.8	153.4	6.2 53.1		3.5 17.2	5.0	4.2	242.6	5364	38.0	0.16	0.45
	TOTAL	3		15,553						57.7	2029	42.2	HC/FC	68.5	31.4	5.0	189.3	96.6		37.9	15.0	10.1	348.9	15,553	99.9	0.13	0.42
6B	F	1	46.7	4414	10.5	2.5	2.7	0.2 (CREW) 2.2 (EXP)	1.1	19.2	784 9	16.3 0.1 (EU 3)	EU 25	25.0	10.6	1.7	17.8	14.4 5.7		8.0 1.2	5.0	3.4	55.5	4414	35.6	0.18	0.46
	BLH	1			SAME AS CONCEPT 6									18.5	—	1.0	17.6	7.4		7.3	5.0	—	37.3				
	RC	1			SAME AS CONCEPT 6A									25.0	13.0	1.8	153.4	59.3		20.7	5.0	4.2	242.6				
	TOTAL	3		13,930						55.2	1949	36.9	HC/FC EU 25	68.5	23.6	4.5	188.8	86.8		37.2	5.0	7.6	335.4	13,930	92.1	0.14	0.40
6C	F	1	49.7	4772	10.8	2.8	2.7	0.2 (CREW) 2.2 (EXP)	1.1	19.8	607 9 80	13.4 0.1 (EU 3) 5.3 (EU 25-26)	24CM	25.0	8.3	1.5	17.9	14.4 5.7 9.8		7.8 1.2 0.7	5.0	2.7	65.2	4772	38.6	0.15	0.49
	BLH	1			SAME AS CONCEPT 6									18.5	—	1.0	17.6	7.4		7.3	5.0	—	37.3				
	RC	1			SAME AS CONCEPT 6A									25.0	13.0	1.8	153.4	59.3		20.7	5.0	4.2	242.6				
	TOTAL	3		14,288						55.8	1852	39.3	HC/FC 24CM	68.5	21.3	4.3	188.9	96.6		37.7	15.0	6.9	345.1	14,288	95.1	0.13	0.41
6D	F	1	39.7	3579	9.6	2.0	2.7	0.2 (CREW) 2.2 (EXP)	1.1	17.8	607 9	13.4 0.1 (EU 3)	24 CM EU 25	25.0	6.3	1.4	17.4	14.4 5.7		7.8 1.2	5.0	2.0	53.5	3579	31.3	0.17	0.43
	BLH	1			SAME AS CONCEPT 6									18.5	—	1.0	17.6	7.4		7.3	5.0	—	37.3				
	RC	1			SAME AS CONCEPT 6A									25.0	13.0	1.8	153.4	59.3		20.7	5.0	4.2	242.6				
	TOTAL	3		13,095						53.8	1772	34.0	HC/FC EU 25 24CM	68.5	19.3	4.2	188.4	86.8		37.0	5.0	6.2	333.4	13,095	87.8	0.14	0.39

[1] BASED ON INSIDE USABLE DIAMETER. EXCLUDES COMMON SUBSYSTEMS COMPARTMENT. [2] ASSUMES 90-DAY RESUPPLY [3] EXCLUDES AIRLOCK

Figure I-28. Concept No. 6, Sheet 4

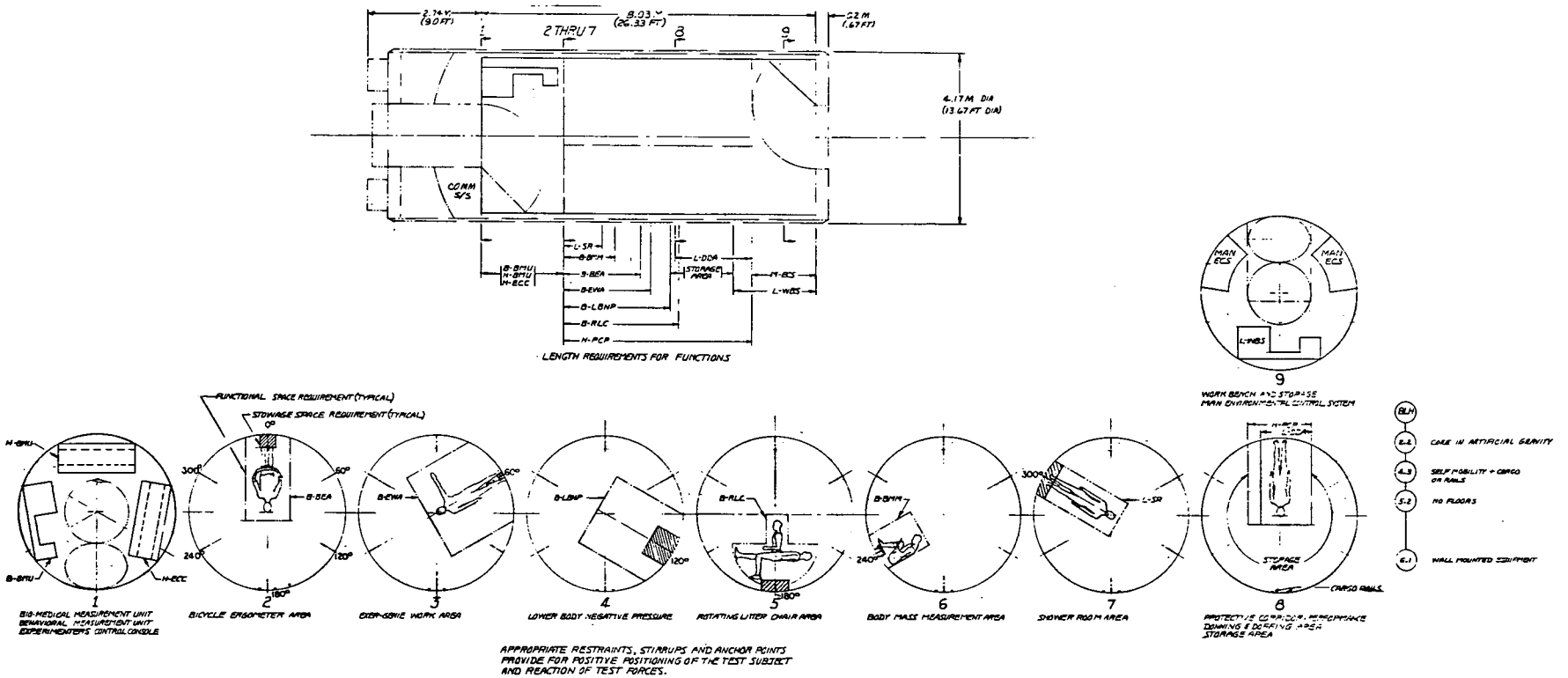


Figure I-29. Concept No. 7, BLH Module - Sheet 1

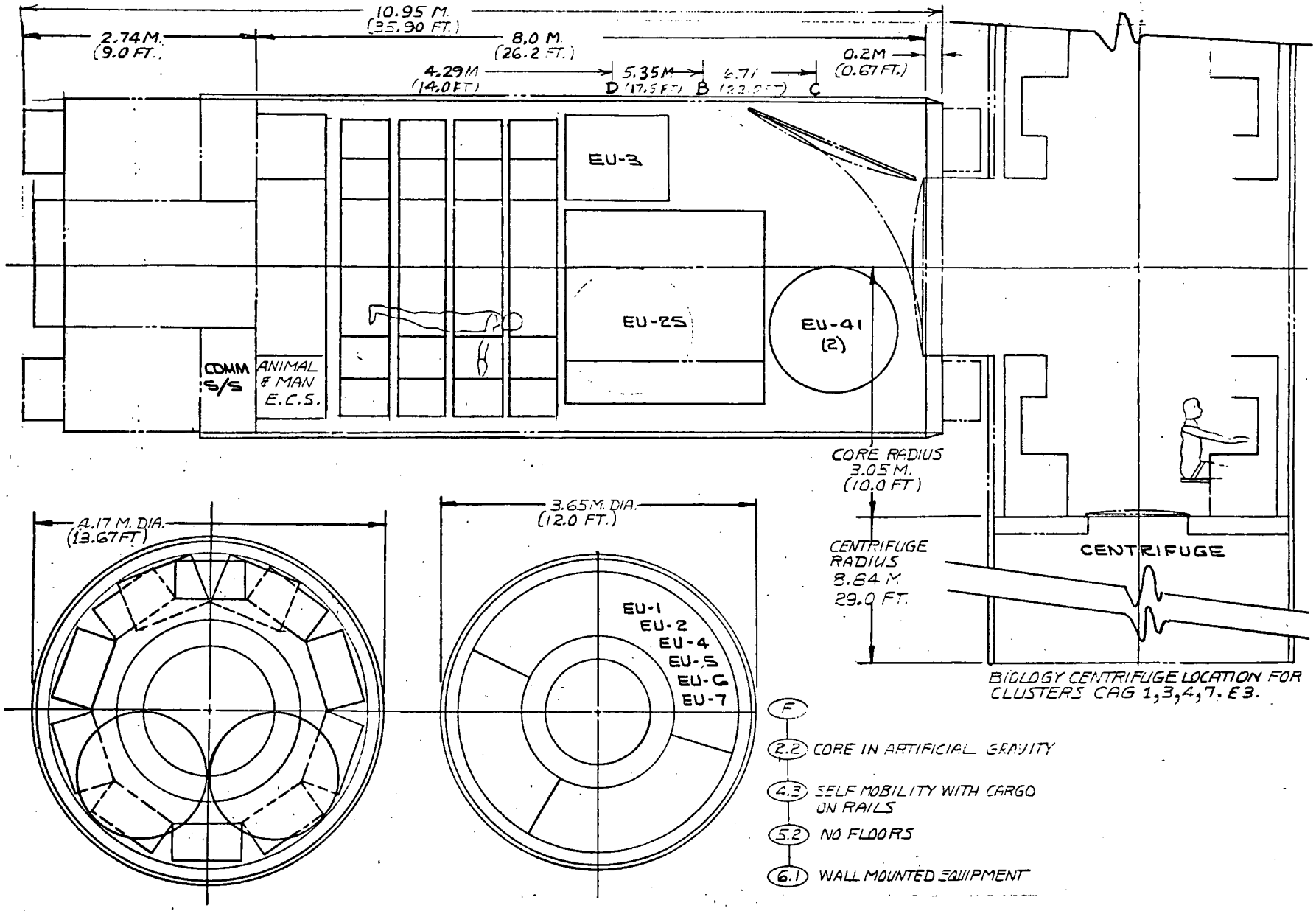
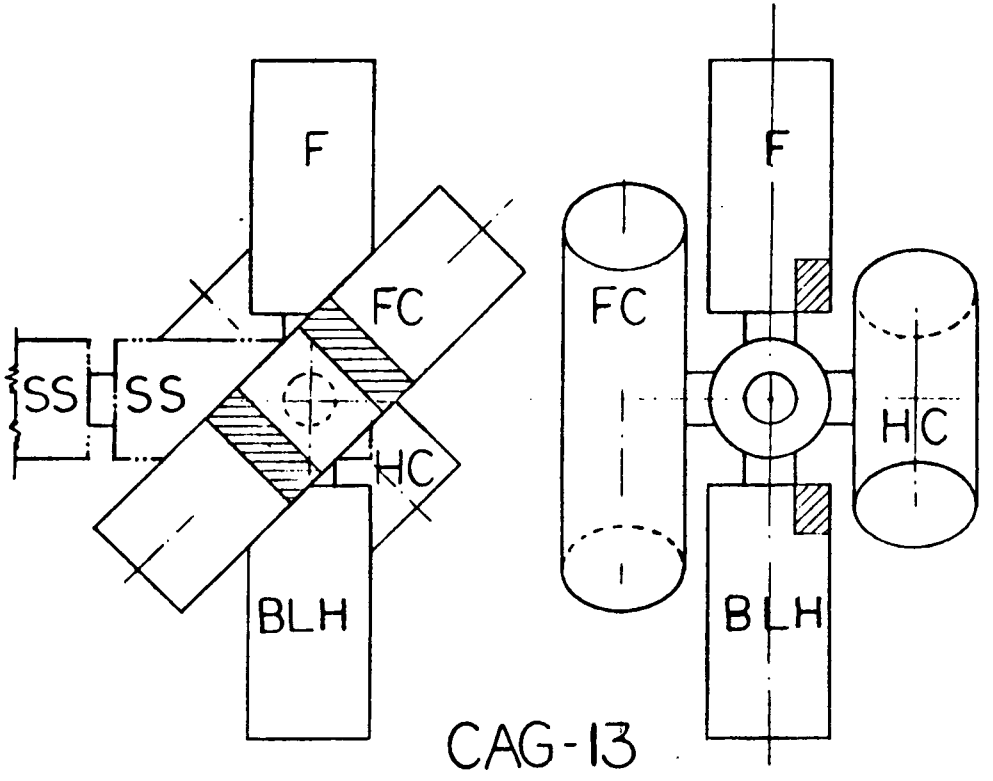
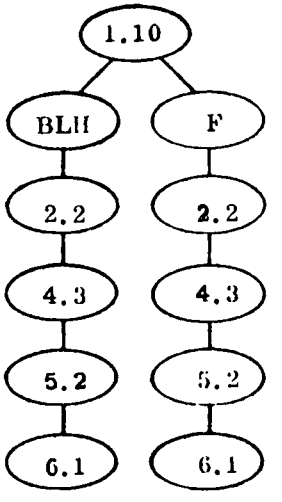


Figure I-29. Concept No. 7, F Module - Sheet 2





B + L + H and F

CORE IN ARTIFICIAL GRAVITY

SELF MOBILITY WITH CARGO ON RAILS

NO FLOORS

WALL MOUNTED EQUIPMENT

ALTERNATES:

CAG-1 -3 -4 -5 CAG-6

CAG-8 -9 -10 -11 CAG-12

Figure I-29. Concept No. 7, Module Cluster - Sheet 3

FIRST GENERATION. CONCEPT NO. 7

DES. CON. #	MODULE TYPE	SIZE OF MODULE REQ'D: # OF MOD.	LENGTH (FT)	VOLUME (FT³)	WEIGHT, LBS. X 1000: MOD. STRUCT.	INTERFACE STRUCT.	COMMON SUBSYS.	ECS	CONSUM.[2]	TOTAL[3]	SCIENTIFIC & SUPPORT EQUIPMENT PAYLOAD: VOLUME (FT³)	WEIGHT (LBS) X 1000	SCI. RES.	SHUTTLE LAUNCHES REQ'D: WEIGHT OF DEDICATED LAUNCHES	WEIGHT OF CARGO LAUNCHES	TOTAL # OF LNCH.	COSTS: MODULE ENG. SUBSYS.	SCIENTIFIC & SUPPORT EQUIP. DEVE.	SCIENTIFIC & SUPPORT EQUIP. UNIT	LAUNCH MOD.	LAUNCH CARGO	TOTAL	TOTAL FACILITY[1] VOLUME (FT³)	TOTAL FACILITY[3] WEIGHT (LBS) X 000	ε_v[1]	%[3] P/L
7	F	1	35.9	3126	9.1	3.3	2.7	0.2 (CREW) 2.2 (EXP)	1.1	18.6	784 9 80	16.3 0.1 (EU 3) 5.3 (EU 25-26)	100%	25.0	15.3	2.0	17.7	14.4 5.7 9.8	8.0 1.2 0.7	5.0	4.9	67.4	3126	40.3	0.28	0.54
	BLH	1	36.0	3138	9.1	0.5	2.7	0.7 (CREW)	0.1	13.1	179 106	2.2 1.1 (EU 11)	100%	16.4	—	1.0	17.1	7.1 0.3	7.1 0.2	5.0	—	36.8	3138	16.4	0.09	0.20
	FC	1	60.0	5364	10.1	3.0	3.1	0.2 (CREW) 2.9 (EXP)	1.5	20.8	336 535	7.0 10.2 (CORE-3)	100%	25.0	13.0	1.8	10.0	6.2 53.1	3.5 17.2	5.0	4.2	99.2	5364	38.0	0.16	0.45
	HC	1		2045						23.7	54	0.4	100%	24.1	—	1.0	153.4	1.2	0.2	5.0	—	159.8	2045	24.1	0.03	0.02
	TOTAL	4		13,673						76.2	2083	42.6	100%	90.5	28.3	5.8	199.2	97.8	38.1	20.0	9.1	363.2	13,673	118.8	0.15	0.36
7A	F	1			SAME AS CONCEPT 7									25.0	15.3	2.0	17.7	29.9	9.9	5.0	4.9	67.4				
	BLH	1			SAME AS CONCEPT 7									16.4	—	1.0	17.1	7.4	7.3	5.0	—	36.8				
	RC	1	60.0	5364	10.1	3.0	3.1	0.2 (CREW) 2.9 (EXP)	1.5	20.8	336 535	7.0 10.2 (CORE-3)	-HC/FC	25.0	13.0	1.8	153.4	6.2 53.1	3.5 17.2	5.0	4.2	242.6	5364	38.0	0.16	0.45
	TOTAL	3		11,628						52.5	2029	42.2	-HC/FC	66.4	28.3	4.8	185.2	96.6	37.9	15.0	9.1	346.8	11,628	94.7	0.17	0.45
7B	F	1	27.2	2088	8.0	2.5	2.7	0.2 (CREW) 2.2 (EXP)	1.1	16.7	784 9	16.3 0.1 (EU 3)	-EU 25	25.0	8.1	1.5	17.3	14.4 5.7	8.0 1.2	5.0	2.6	54.2	2088	33.1	0.38	0.50
	BLH	1			SAME AS CONCEPT 7									16.4	—	1.0	17.1	7.4	7.3	5.0	—	36.8				
	RC	1			SAME AS CONCEPT 7A									25.0	13.0	1.8	153.4	59.3	20.7	5.0	4.2	242.6				
	TOTAL	3		10,590						50.6	1949	36.9	-HC/FC -EU 25	66.4	21.1	4.3	187.2	86.8	37.2	15.0	6.8	333.6	10,590	87.5	0.18	0.42
7C	F	1	31.7	2625	8.6	2.8	2.7	0.2 (CREW) 2.2 (EXP)	1.1	17.6	607 9 80	13.4 0.1 (EU 3) 5.3 (EU 25-26)	-24CM	25.0	11.4	1.7	17.4	14.4 5.7 9.8	7.8 1.2 0.7	5.0	3.6	65.6	2625	36.4	0.27	0.52
	BLH	1			SAME AS CONCEPT 7									16.4	—	1.0	17.1	7.4	7.3	5.0	—	36.8				
	RC	1			SAME AS CONCEPT 7A									25.0	13.0	1.8	153.4	59.3	20.7	5.0	4.2	242.6				
	TOTAL	3		11,127						51.5	1852	39.3	-HC/FC -24CM	66.4	24.4	4.5	187.9	96.6	37.7	15.0	7.8	345.0	11,127	90.8	0.17	0.43
7D	F	1	23.7	1670	7.6	2.0	2.7	0.2 (CREW) 2.2 (EXP)	1.1	15.8	607 9	13.4 0.1	-24CM -EU25	25.0	4.3	1.3	17.1	14.4 5.7	7.8 1.2	5.0	1.4	52.6	1670	29.3	0.37	0.46
	BLH	1			SAME AS CONCEPT 7									16.4	—	1.0	17.1	7.4	7.3	5.0	—	36.8				
	RC	1			SAME AS CONCEPT 7A									25.0	13.0	1.8	153.4	59.3	20.7	5.0	4.2	242.6				
	TOTAL	3		10,172						49.7	1772	34.0	-HC/FC -EU25 -24CM	66.4	17.3	4.1	187.6	86.8	37.0	15.0	5.6	332.0	10,172	83.7	0.17	0.41

[1] BASED ON INSIDE USABLE DIAMETER. EXCLUDES COMMON SUBSYSTEMS COMPARTMENT, AIRLOCK. [2] ASSUMES 90-DAY RESUPPLY [3] EXCLUDES AIRLOCK

Figure I-29. Concept No. 7, Sheet 4

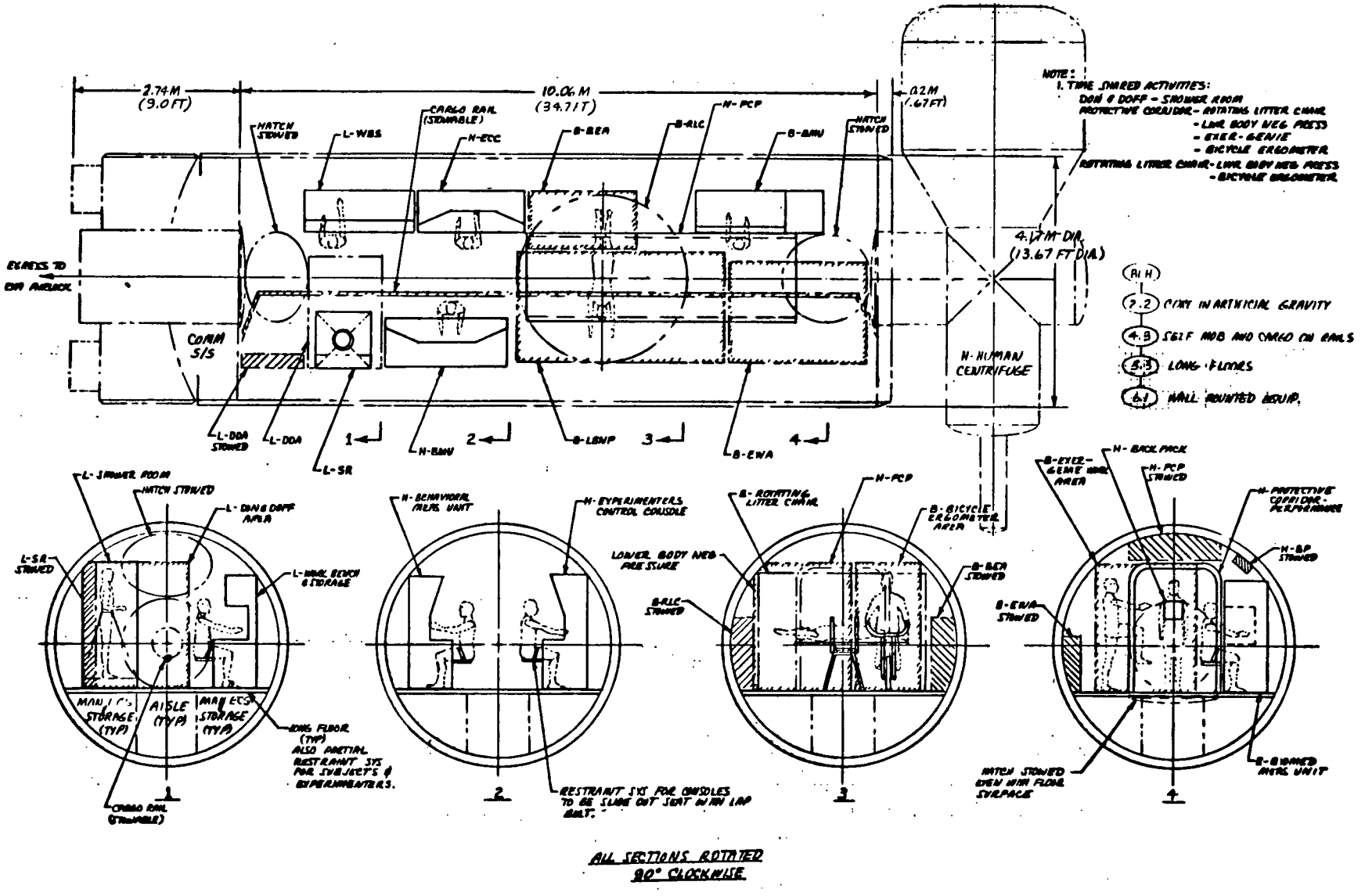


Figure I-30. Concept No. 8, BLH Module - Sheet 1

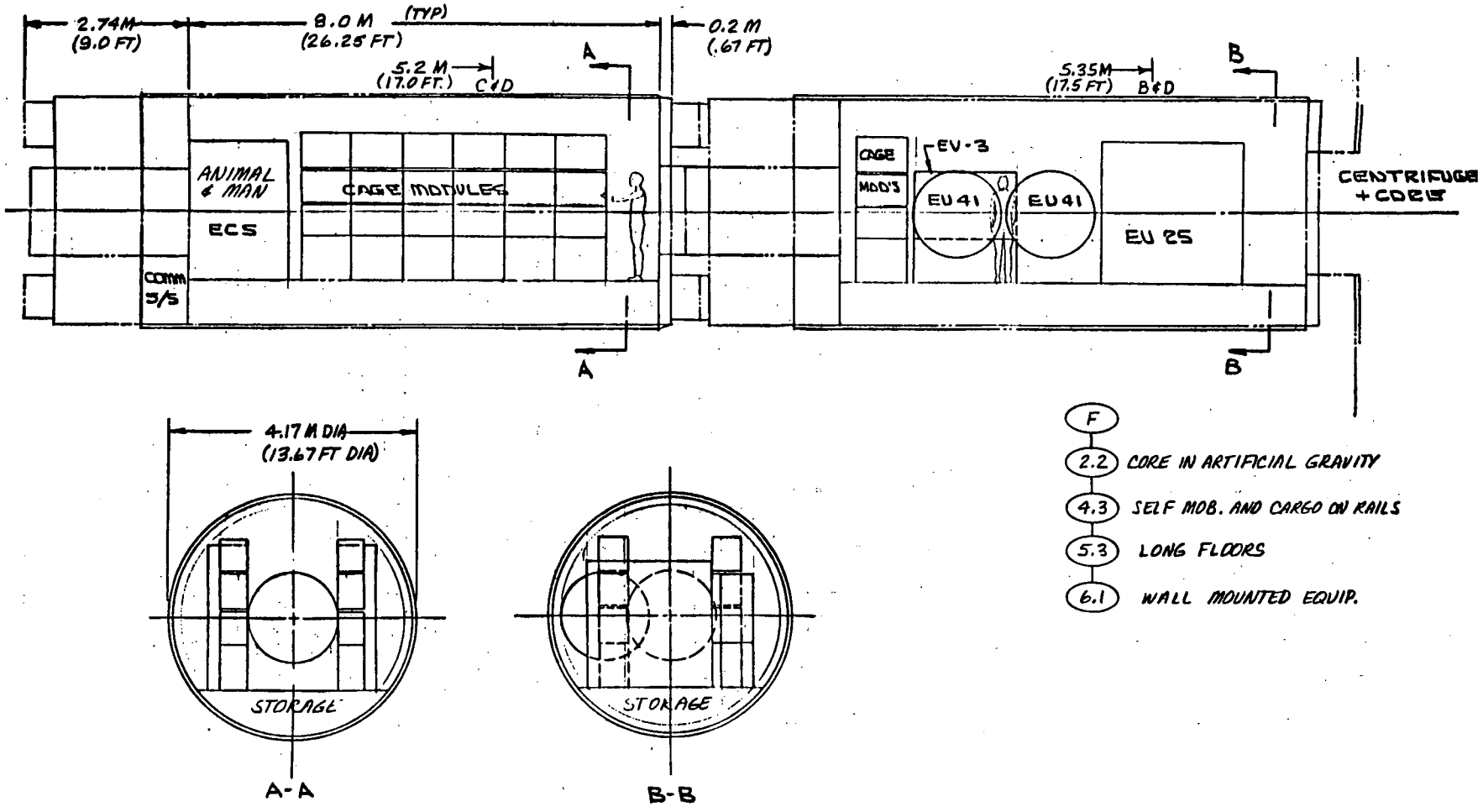
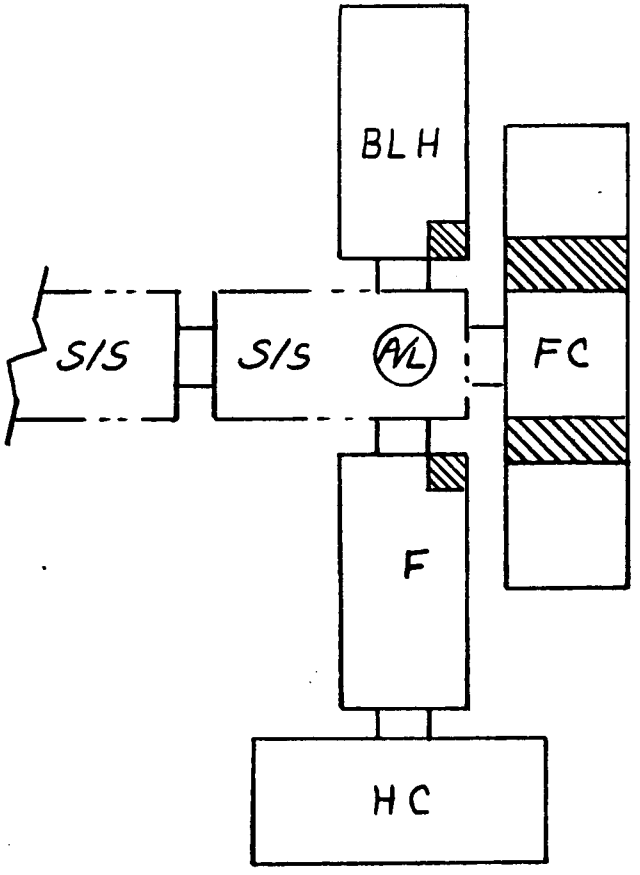
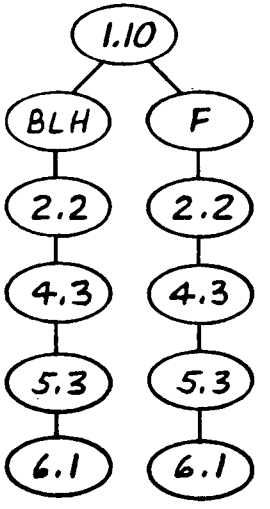


Figure I-30. Concept No. 8, F Module - Sheet 2



CAG-10



B+L+H AND F

CORE IN ARTIFICIAL GRAVITY

SELF MOB AND CARGO ON RAILS

LONG FLOORS

WALL MOUNTED EQUIP.

ALTERNATES:
CAG-2
CAG-4
CAG-6
CAG-8
CAG-11

Figure I-30. Concept No. 8, Module Cluster - Sheet 3

FIRST GENERATION CONCEPT NO. 8

DES. CON. #	MODULE TYPE	# OF MOD.	SIZE OF MODULE REQUIRED: LENGTH (FT)	VOLUME[1] (FT³)	WEIGHT, LBS. X 1000: MOD. STRUCT.	INTER-FACE STRUCT.	COMMON SUBSYS.	ECS	CONSUM.[2]	TOTAL[3]	SCIENTIFIC & SUPPORT EQUIPMENT PAYLOAD: VOLUME (FT³)	WEIGHT (LBS) X 1000	SCI. REQ.	SHUTTLE LAUNCHES REQ'D: WEIGHT OF DEDICATED LAUNCHES	WEIGHT OF CARGO LAUNCHES	TOTAL # OF LNCS	COSTS: MODULE AND SUBSYS.	SCIENTIFIC & SUPPORT EQUIP.: DEVE.	UNIT	LAUNCH: MOD.	CARGO	TOTAL	TOTAL FACILITY: VOLUME[1] (FT³)	WEIGHT[3] (LBS) X 1000	E_V[1]	%[3] P/L
8	F	2	36.0	3138	9.1	1.9	2.7	0.1 (CREW) 1.5 (EXP)	0.4	15.7	392	8.2	100%	23.9	—	1.0	17.3	7.2	4.0	5.0	—	33.5	3138	23.9	0.12	0.34
			36.0	3138	9.1	2.7	2.7	0.1 (CREW) 0.7 (EXP)	0.7	16.0	392 9 80	8.1 0.1 (FU3) 5.3 (EU25)	100%	25.0	4.5	1.3	17.6	7.2 5.7 9.8	4.0 1.2 0.7	5.0	1.4	52.6	3138	29.5	0.15	0.46
	BLH	1	44.5	4152	10.2	1.5	2.7	0.7 (CREW)	0.1	15.2	179 106	2.2 1.1 (EU11)	100%	18.5	—	1.0	17.6	7.1 0.3	7.1 0.2	5.0	—	37.3	4152	18.5	0.07	0.18
	FC	1	60.0	5364	10.1	3.0	3.1	0.2 (CREW) 2.9 (EXP)	1.5	20.8	336 535	7.0 10.2 (CORE-3)	100%	25.0	13.0	1.8	10.0	6.2 53.1	3.5 17.2	5.0	4.2	99.2	5364	38.0	0.16	0.45
	HC	1		2045						23.7	54	0.4	100%	24.1	—	1.0	153.4	1.2	0.2	5.0	—	159.8	2045	24.1	0.03	0.02
	TOTAL	5		17,837						91.4	2083	42.6	100%	116.5	17.5	6.1	215.9	97.8	38.1	25.0	5.6	382.4	17,837	134.0	0.12	0.32
8A	F	2			SAME AS CONCEPT 8									23.9	—	1.0	17.3	7.2	4.0	5.0	—	33.5				
					SAME AS CONCEPT 8									25.0	4.5	1.3	17.6	22.7	5.9	5.0	1.4	52.6				
	BLH	1			SAME AS CONCEPT 8									18.5	—	1.0	17.6	7.4	7.3	5.0	—	37.3				
	RC	1	60.0	5364	10.1	3.0	3.1	0.2 (CREW) 2.9 (EXP)	1.5	20.8	336 535	7.0 10.2 (CORE-3)	100%	25.0	13.0	1.8	153.4	6.2 53.1	3.5 17.2	5.0	4.2	242.6	5364	38.0	0.16	0.45
	TOTAL	4		15,792						67.7	2029	42.2	-HC/FC	92.4	17.5	5.1	205.9	96.6	37.9	20.0	5.6	366.0	15,792	109.9	0.13	0.38
8B	F	2			SAME AS CONCEPT 8									23.9	—	1.0	17.3	7.2	4.0	5.0	—	33.5				
			27.2	2088	8.0	1.9	2.7	0.1 (CREW) 0.7 (EXP)	0.7	14.1	392 9	8.1 0.1 (FU 3)	-EU 25	22.3	—	1.0	17.1	7.2 5.7	4.0 1.2	5.0	—	40.2	2088	22.3	0.19	0.37
	BLH	1			SAME AS CONCEPT 8									18.5	—	1.0	17.6	7.4	7.3	5.0	—	37.3				
	RC	1			SAME AS CONCEPT 8A									25.0	13.0	1.8	153.4	59.3	20.7	5.0	4.2	242.6				
	TOTAL	4		14,742						65.8	1949	36.9	-HC/FC -EU 25	89.7	13.0	4.8	205.4	86.8	37.2	20.0	4.2	353.6	14,742	102.7	0.13	0.36
8C	F	2	26.7	2028	8.0	2.3	2.7	0.1 (CREW) 1.5 (EXP)	0.4	15.0	215	5.2	-24 CM	20.2	—	1.0	17.2	7.2	3.8	5.0	—	33.2	2028	20.2	0.15	0.26
					SAME AS CONCEPT 8									25.0	4.5	1.3	17.6	22.7	5.9	5.0	1.4	52.6				
	BLH	1			SAME AS CONCEPT 8									18.5	—	1.0	17.6	7.4	7.3	5.0	—	37.3				
	RC	1			SAME AS CONCEPT 8A									25.0	13.0	1.8	153.4	59.3	20.7	5.0	4.2	242.6				
	TOTAL	4		14,682						67.0	1852	39.3	-HC/FC -24 CM	88.7	17.5	5.1	205.8	96.6	37.7	20.0	5.6	365.7	14,682	106.3	0.13	0.37
8D	F	2			SAME AS CONCEPT 8C									20.2	—	1.0	17.2	7.2	3.8	5.0	—	33.2				
					SAME AS CONCEPT 8B									22.3	—	1.0	17.1	12.9	5.2	5.0	—	40.2				
	BLH	1			SAME AS CONCEPT 8									18.5	—	1.0	17.6	7.4	7.3	5.0	—	37.3				
	RC	1			SAME AS CONCEPT 8A									25.0	13.0	1.8	153.4	59.3	20.7	5.0	4.2	242.6				
	TOTAL	4		13,632						65.1	1772	34.0	-HC/FC -EU 25 -24 CM	86.0	13.0	4.8	205.3	86.8	37.0	20.0	4.2	353.3	13,632	99.1	0.13	0.34

[1] BASED ON INSIDE USABLE DIAMETER, EXCLUDES COMMON SUBSYSTEMS COMPARTMENT, AIRLOCK [2] ASSUMES 90-DAY RESUPPLY [3] EXCLUDES AIRLOCK

Figure I-30. Concept No. 8, Sheet 4

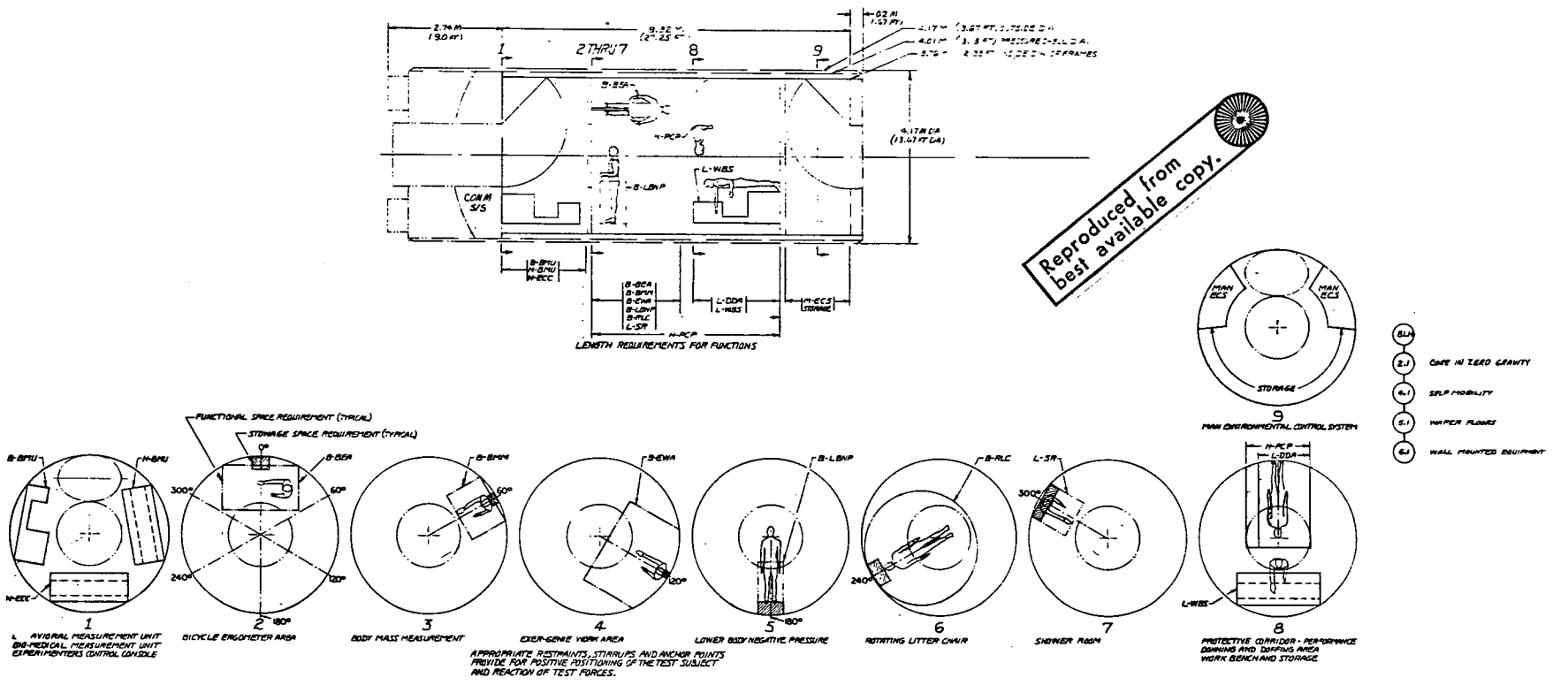


Figure I-31. Concept No. 9, BLH Module - Sheet 1

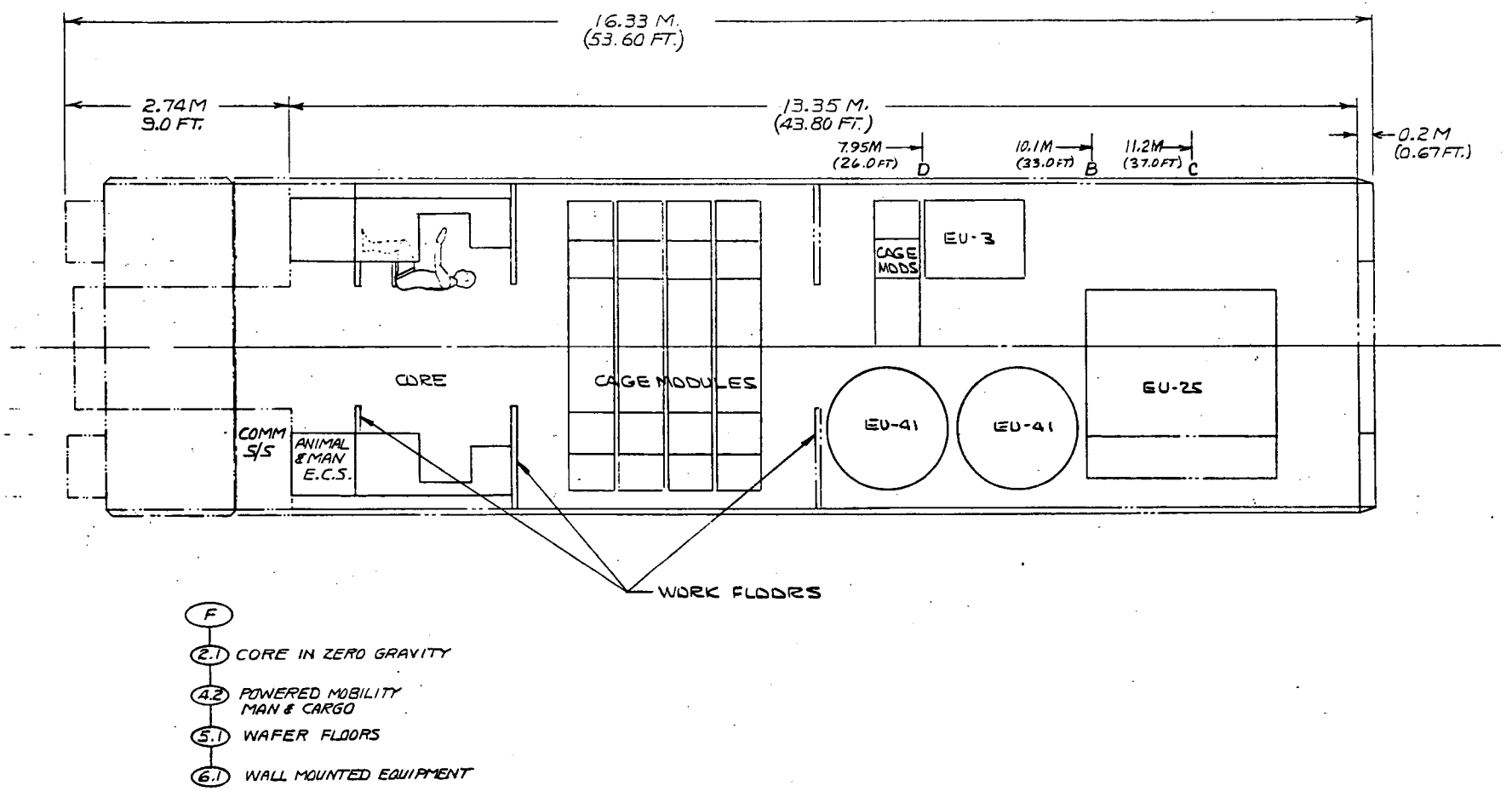
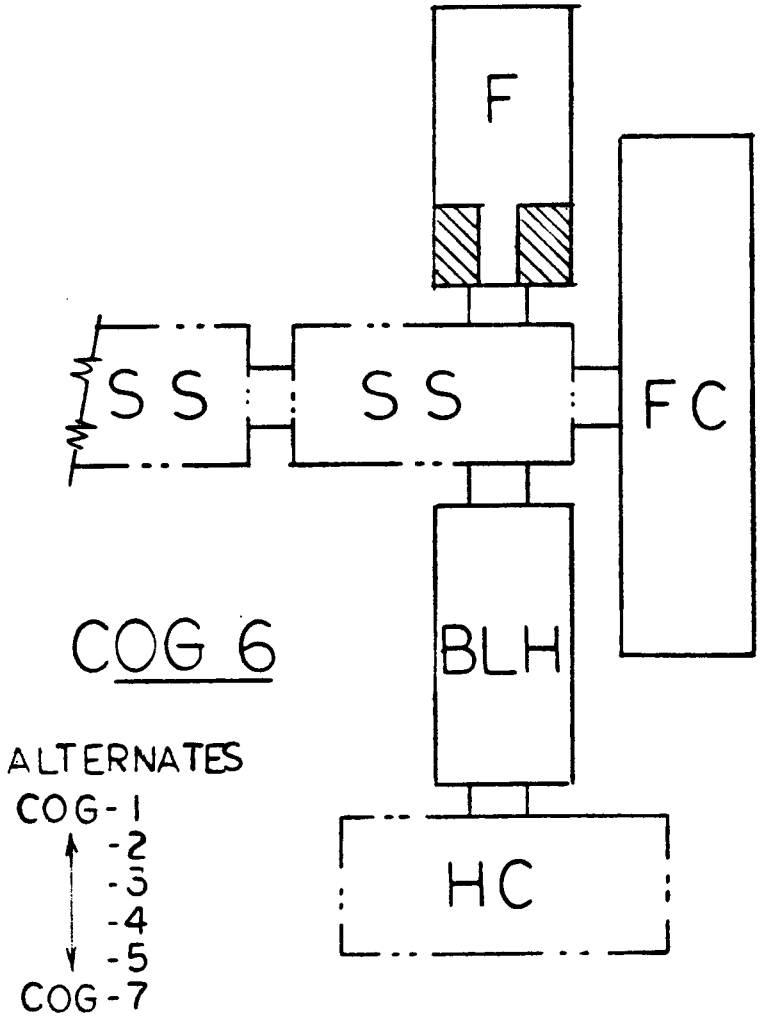


Figure I-31. Concept No. 9, F Module - Sheet 2



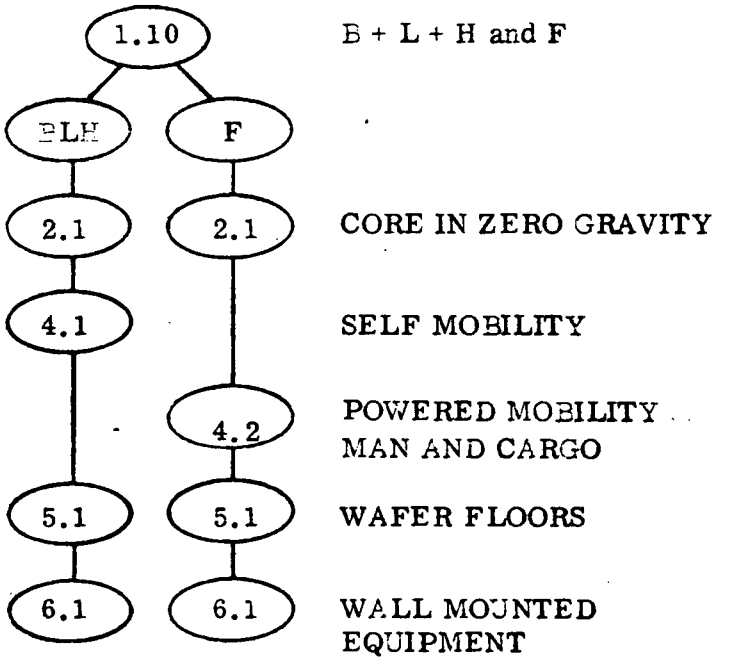


Figure I-31. Concept No. 9, Module Cluster - Sheet 3

FIRST GENERATION CONCEPT NO. 9

DES. CON. #	MODULE TYPE	SIZE OF MODULE REQUIRED									SCIENTIFIC & SUPPORT EQUIPMENT PAYLOAD			SHUTTLE LAUNCHES REQ'D			COSTS (M of $)						TOTAL FACILITY		ε_v [1]	% [3] P/L
		# OF MODS.	LENGTH (FT)	VOLUME (FT³)	WEIGHT, LBS. X 1000 MOD. STRUCT.	INTERFACE STRUCT.	COMMON SUBSYS.	ECS	CONSUM. [2]	TOTAL [3]	VOLUME (FT³)	WEIGHT (LBS) X1000	SCI. RES.	WEIGHT OF DEDICATED LAUNCHES	WEIGHT OF CARGO LAUNCHES	TOTAL # OF LNCHS	MODULE AND SUBSYS.	SCIENTIFIC & SUPPORT EQUIP. DEVEL.	SCIENTIFIC & SUPPORT EQUIP. UNIT	LAUNCH MOD.	LAUNCH CARGO	TOTAL	VOLUME (FT³)	WEIGHT (LBS) X 000		
9	F	1	53.5	5225	11.3	5.9	2.7	0.2 (CREW) 2.2 (EXP)	1.1	23.4	784 544 80	16.3 10.3 (CORE) 5.3 (EU25-26)	100%	25.0	30.3	3.0	18.6	14.4 58.8 9.8	3.0 18.4 0.7	5.0	9.7	143.4	5225	55.3	0.27	0.58
	BLH	1	37.0	3257	9.2	1.2	2.7	0.7 (CREW)	0.1	13.9	179 106	2.2 1.1 (EU 11)	100%	17.2	—	1.0	17.3	7.1 0.3	7.1 0.2	5.0	—	37.0	3257	17.2	0.09	0.19
	FC	1	60.0	5364	10.1	1.5	3.1	0.2 2.4	1.5	19.3	336	7.0	100%	25.0	1.3	1.1	10.9	6.2	3.5	5.0	.4	25.1	5364	26.3	0.06	0.27
	HC	1		2045						23.7	54	0.4	100%	28.1	—	1.0	153.4	1.2	0.2	5.0	—	159.8	2045	24.1	0.03	0.02
	TOTAL	4		15,891						80.3	2083	42.6	100%	92.3	31.6	6.1	199.3	97.8	38.1	20.0	10.1	365.3	15,291	122.9	0.13	0.35
9A	F	1		SAME AS CONCEPT 9										25.0	30.3	3.0	18.6	93.0	27.1	5.0	9.7	143.4				
	BLH	1		SAME AS CONCEPT 9										17.2	—	1.0	17.3	7.4	7.3	5.0	—	37.0				
	RC	1	60.0	5364	10.1	1.5	3.1	0.2 2.9	1.5	19.3	336	7.0	-HC/FC	25.0	1.3	1.1	153.4	6.2	3.5	5.0	.4	168.5	5364	26.3	0.06	0.27
	TOTAL	3		13,846						56.6	2029	42.2	-HC/FC	67.2	31.6	5.1	159.3	96.6	37.9	15.0	10.1	318.9	13,846	98.8	0.15	0.43
9B	F	1	42.7	3937	10.0	5.1	2.7	0.2 (CREW) 2.2 (EXP)	1.1	21.3	784 544	16.3 10.3 (CORE)	-EU 25	25.0	22.3	2.5	18.3	14.4 58.8	8.0 18.4	5.0	7.3	130.2	3937	47.9	0.34	0.56
	BLH	1		SAME AS CONCEPT 9										17.2	—	1.0	17.3	7.4	7.3	5.0	—	37.0				
	RC	1		SAME AS CONCEPT 9A										25.0	1.3	1.1	153.4	6.2	3.5	5.0	.4	168.5				
	TOTAL	3		12,558						54.5	1949	36.9	-HC/FC -EU25	67.2	24.6	4.6	189.0	86.8	37.2	15.0	7.7	335.7	12,558	91.4	0.16	0.40
9C	F	1	46.7	4414	10.5	5.5	2.7	0.2 (CREW) 2.2 (EXP)	1.1	22.2	607 544 80	13.4 10.3 (CORE) 5.3 (EU 25-26)	-24CM	25.0	26.2	2.7	18.4	14.4 58.8 9.8	7.8 18.4 0.7	5.0	8.4	141.7	4414	51.2	0.28	0.57
	BLH	1		SAME AS CONCEPT 9										17.2	—	1.0	17.3	7.4	7.3	5.0	—	37.0				
	RC	1		SAME AS CONCEPT 9A										25.0	1.3	1.1	153.4	6.2	3.5	5.0	.4	168.5				
	TOTAL	3		13,035						55.4	1852	39.3	-HC/FC -24CM	67.2	27.5	4.8	189.1	96.6	37.7	15.0	9.8	347.5	13,035	94.7	0.14	0.41
9D	F	1	35.7	3102	9.1	4.7	2.7	0.2 (CREW) 2.2 (EXP)	1.1	20.0	607 544	13.4 10.3 (CORE)	-24CM -EU25	25.0	18.7	2.2	18.0	14.4 58.8	7.8 18.4	5.0	6.0	128.4	3102	43.7	0.37	0.54
	BLH	1		SAME AS CONCEPT 9										17.2	—	1.0	17.3	7.4	7.3	5.0	—	37.0				
	RC	1		SAME AS CONCEPT 9A										25.0	1.3	1.1	153.4	6.2	3.5	5.0	.4	168.5				
	TOTAL	3		11,723						53.2	1772	34.0	-HC/FC -EU25 -24CM	67.2	20.0	4.3	188.7	86.8	37.0	15.0	6.4	333.3	11,723	87.2	0.15	0.39

[1] BASED ON INSIDE USABLE DIAMETER. EXCLUDES COMMON SUBSYSTEMS COMPARTMENT. [2] ASSUMES 90-DAY RESUPPLY [3] EXCLUDES AIRLOCK

Figure I-31. Concept No. 9, Sheet 4

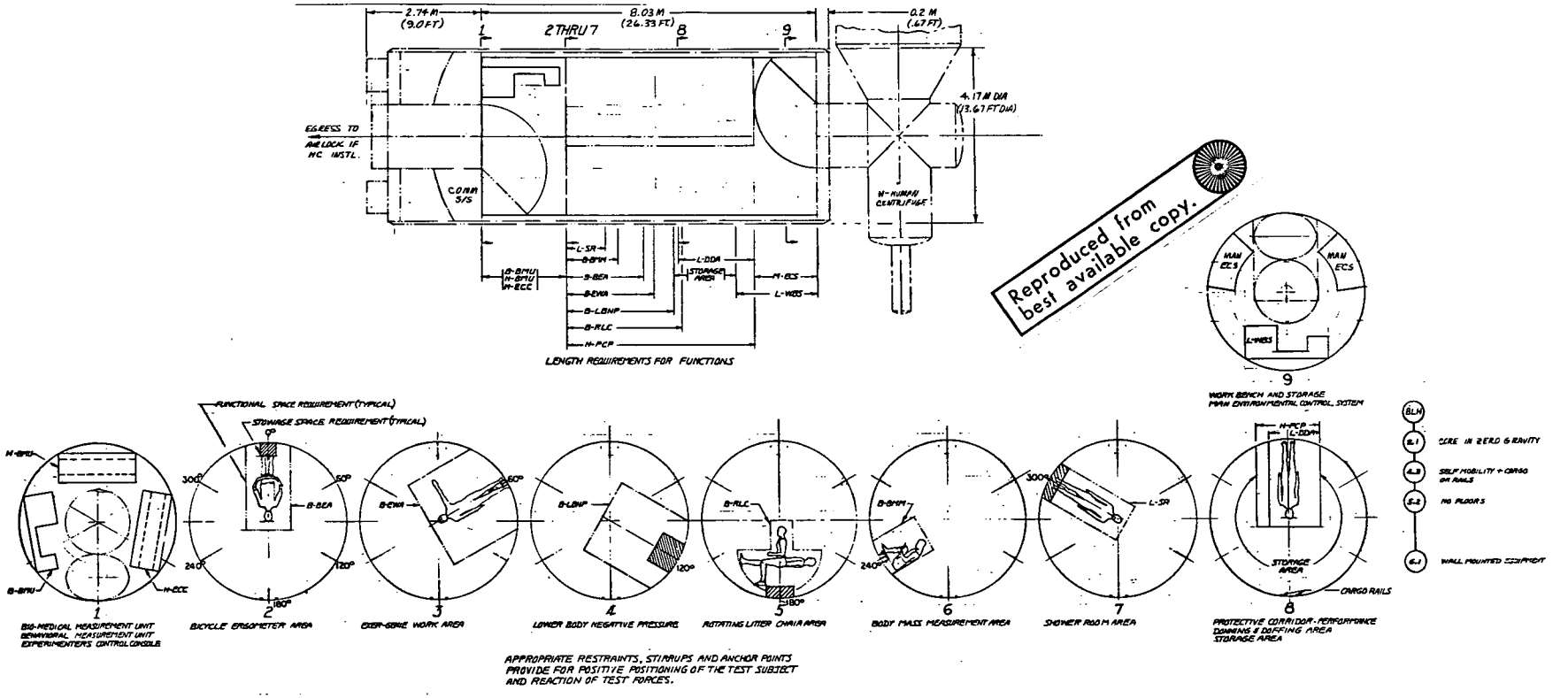
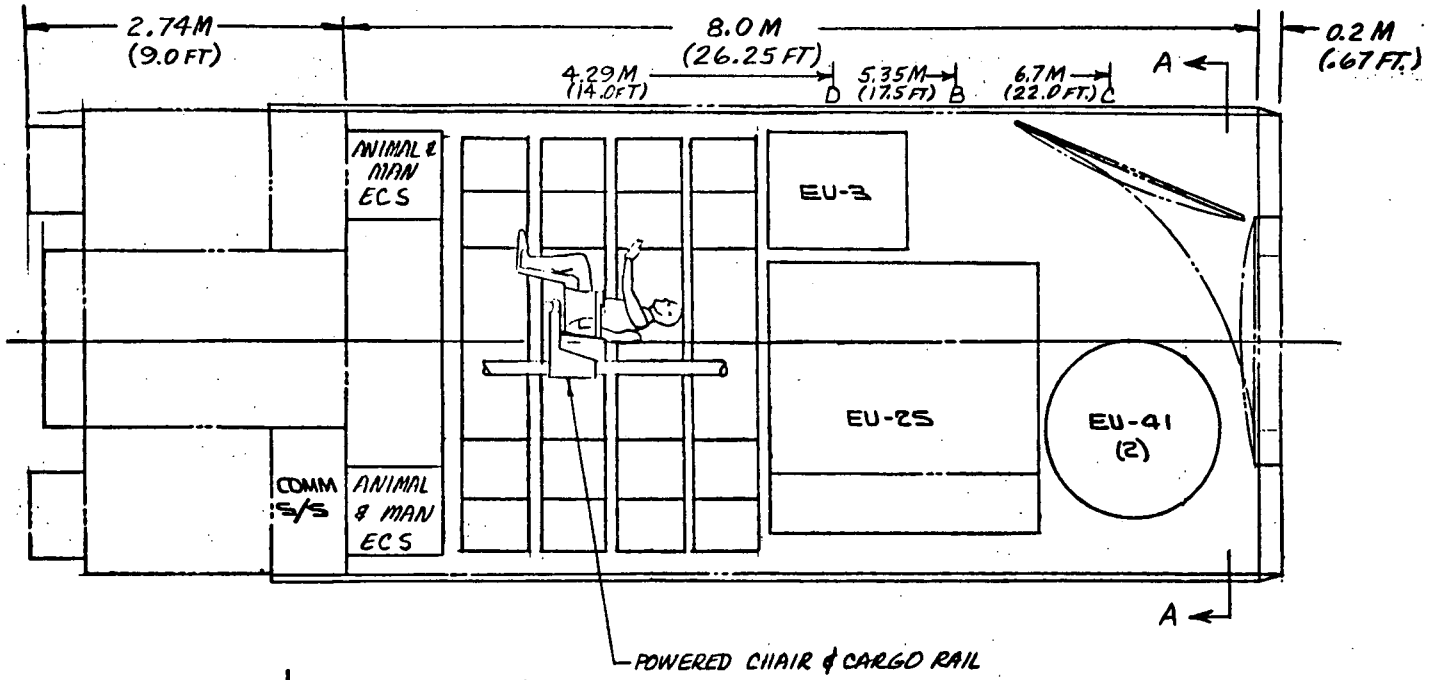
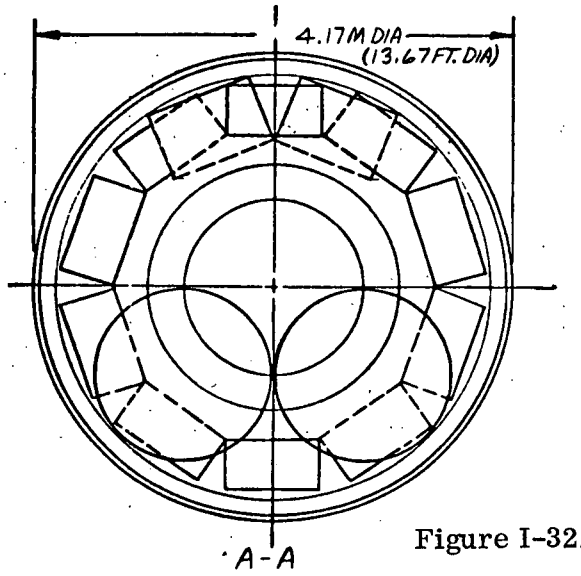


Figure I-32. Concept No. 10, BLH Module - Sheet 1





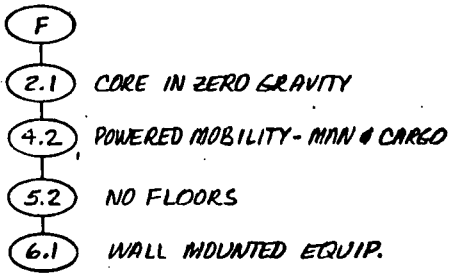


Figure I-32. Concept No. 10, F Module - Sheet 2

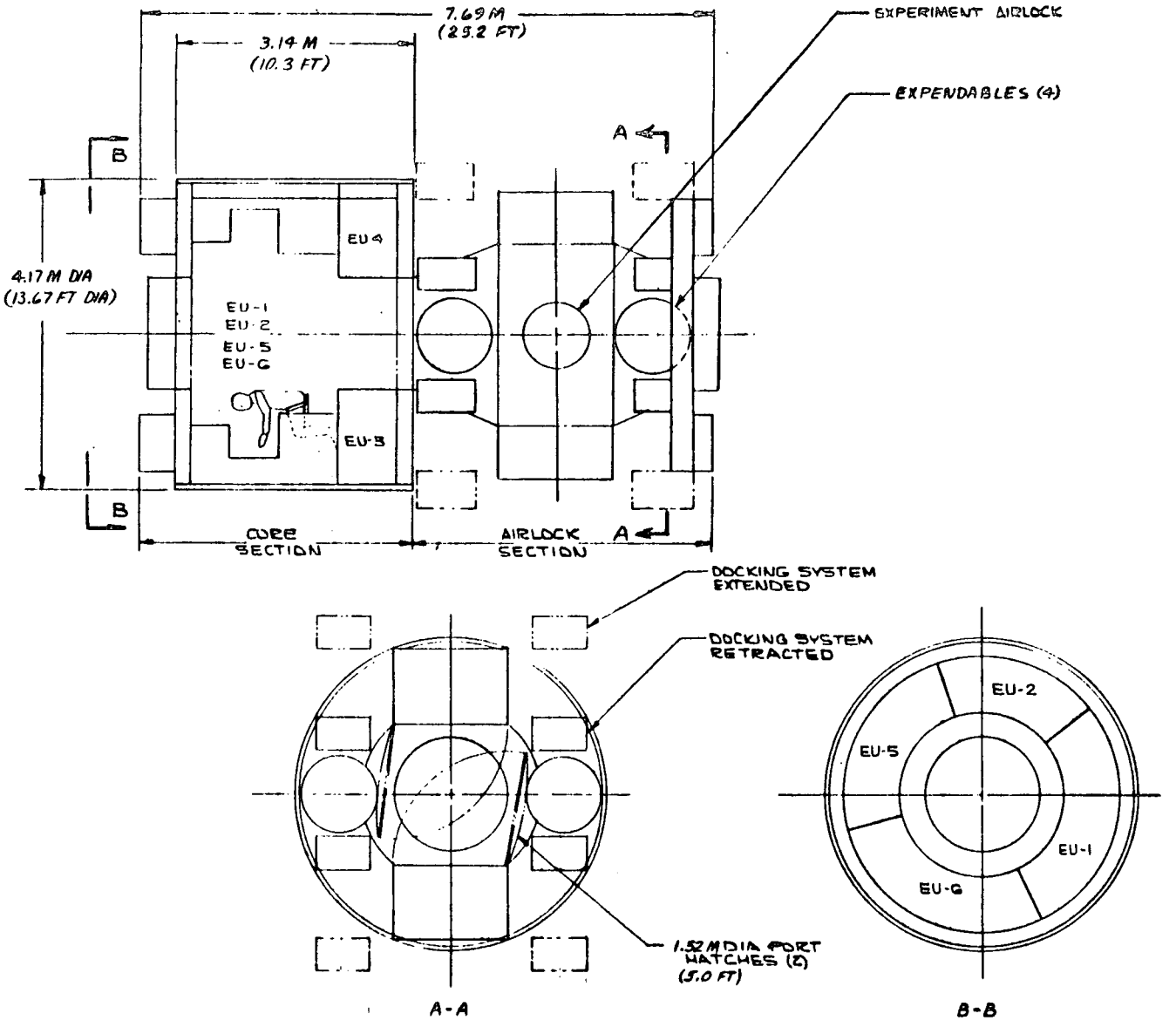
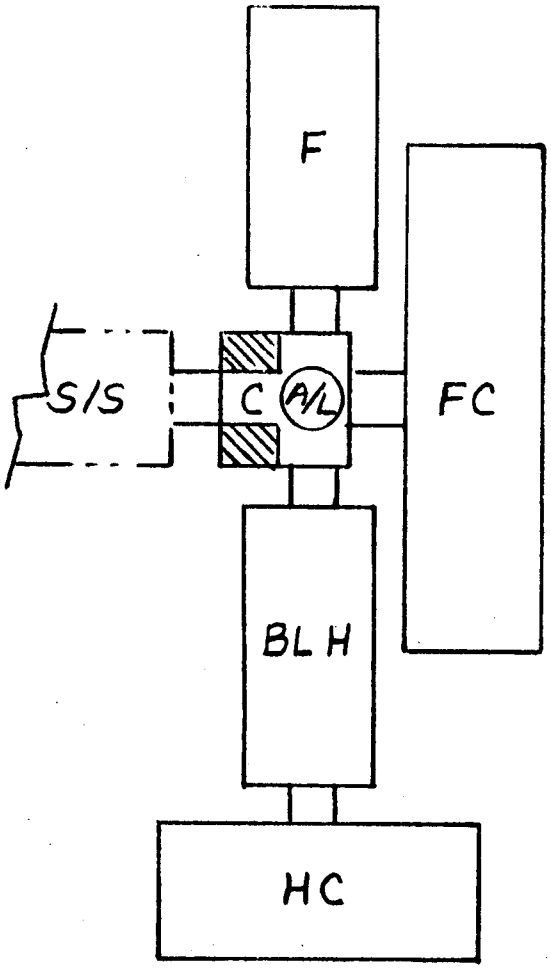
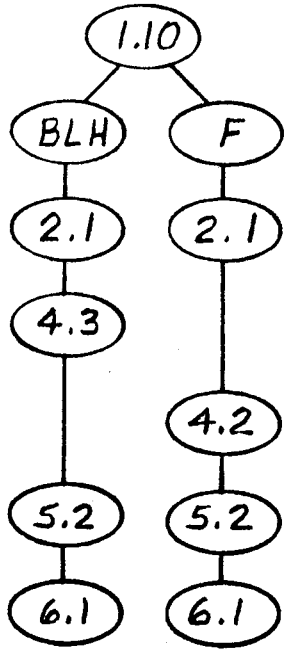


Figure I-32. Concept No. 10, CORE Module - Sheet 3



COG-11



B+L+H AND F

CORE IN ZERO GRAVITY

SELF MOB AND CARGO ON RAILS

POWERED MOBILITY-MAN & CARGO

NO FLOORS

WALL MOUNTED EQUIP.

Figure I-32. Concept No. 10, Module Cluster - Sheet 4

FIRST GENERATION CONCEPT NO. 10

DES. CON. #	MODULE TYPE	SIZE OF MODULE REQUIRED: # OF MOD.	LENGTH (FT)	VOLUME[1] (FT³)	WEIGHT, LBS. X 1000: MOD. STRUCT.	INTER-FACE STRUCT.	COMMON SUBSYS.	ECS	CONSUM[2]	TOTAL[3]	SCIENTIFIC & SUPPORT EQUIPMENT PAYLOAD: VOLUME (FT³)	WEIGHT (LBS) X 1000	SCI. RES.	SHUTTLE LAUNCHES REQ'D: WEIGHT OF DEDICATED LAUNCHES	WEIGHT OF CARGO LAUNCHES	TOTAL # OF LNCHS	COSTS: MODULE AND SUBSYS.	SCIENTIFIC & SUPPORT EQUIP.: DEVEL.	UNIT	LAUNCH: MOD.	CARGO	TOTAL	TOTAL FACILITY: VOLUME[1] (FT³)	WEIGHT[3] (LBS) X 1000	ε_V[1]	% P/L[3]
10	F	1	35.9	3126	9.1	3.3	2.7	0.2 (CREW) 2.2 (EXP)	1.1	18.6	784 9 80	16.3 0.1 (EU 3) 5.3 (EU25-36)	100%	25.0	15.3	2.0	17.7	14.4 5.7 9.8	8.0 1.2 0.7	5.0	4.9	67.4	3126	40.3	0.28	0.54
	BLH	1	36.0	3138	9.1	0.3	2.7	0.5 (CREW)	0.1	13.1	179	2.2	100%	15.3	—	1.0	17.0	7.1	7.1	5.0	—	36.2	3138	15.3	0.06	0.14
	CORE/ A/L	1	10.3	1074	6.9	1.7	—	0.2 (CREW)	—	8.8	106 535	1.1 (EU 11) 10.2 (CORE-3)	100%	9.9	—	1.0	16.9	0.3 53.1	0.2 17.2	5.0	—	92.7	1074	20.1	0.60	0.56
	FC	1	60.0	5364	10.1	1.5	3.1	0.2 2.9	1.5	19.3	336	7.0	100%	25.0	1.3	1.1	10.0	6.2	3.5	5.0	.4	25.1	5364	26.3	0.06	0.27
	HC	1		2045						23.7	54	0.4	100%	24.1	—	1.0	153.4	1.2	0.2	5.0	—	159.8	2045	24.1	0.03	0.02
	TOTAL	5		14,747						83.5	2083	42.6	100%	99.3	16.6	6.1	215.0	97.8	38.1	25.0	9.3	381.2	14,747	126.1	0.14	0.34
10A	F	1		SAME AS CONCEPT 10										25.0	15.3	2.0	17.7	29.9	9.9	5.0	4.9	67.4				
	BLH	1		SAME AS CONCEPT 10										15.3	—	1.0	17.0	7.1	7.1	5.0	—	36.2				
	CORE/ A/L	1		SAME AS CONCEPT 10										9.9	—	1.0	16.9	53.4	17.4	5.0	—	92.7				
	RC	1	60.0	5364	10.1	1.5	3.1	0.2 2.9	1.5	19.3	336	7.0	-HC/FC	25.0	1.3	1.1	153.4	6.2	3.5	5.0	.4	168.5	5364	26.3	0.06	0.27
	TOTAL	4		12702						59.8	2029	42.2	-HC/FC	75.2	16.6	5.1	205.0	96.6	37.9	20.0	5.3	364.8	12,702	102.0	0.16	0.41
10B	F	1	27.2	2088	8.0	2.5	2.7	0.2 (CREW) 2.2 (EXP)	1.1	16.7	784 9	16.3 0.1 (EU 3)	-EU 25	25.0	8.1	1.5	17.3	14.4 5.7	8.0 1.2	5.0	2.6	54.2	2088	33.1	0.38	0.50
	BLH	1		SAME AS CONCEPT 10										15.3	—	1.0	17.0	7.1	7.1	5.0	—	36.2				
	CORE/ A/L	1		SAME AS CONCEPT 10										9.9	-	1.0	16.9	53.4	17.4	5.0	—	92.7				
	RC	1		SAME AS CONCEPT 10A										25.0	1.3	1.1	153.4	6.2	3.5	5.0	.4	168.5				
	TOTAL	4		11,664						57.9	1949	36.9	-HC/FC -EU25	75.2	9.4	4.6	204.6	86.8	37.2	20.0	3.0	351.6	11,664	94.8	0.17	0.39
10C	F	1	31.7	2625	8.6	2.8	2.7	0.2 (CREW) 2.2 (EXP)	1.1	17.6	607 9 80	13.4 0.1 (EU 3) 5.3 (EU25-36)	-24 CM	25.0	11.4	1.7	17.4	14.4 5.7 9.8	7.8 1.2 0.7	5.0	3.6	65.6	2625	36.4	0.27	0.52
	BLH	1		SAME AS CONCEPT 10										15.3	—	1.0	17.0	7.1	7.1	5.0	—	36.2				
	CORE/ A/L	1		SAME AS CONCEPT 10										9.9	—	1.0	16.9	53.4	17.4	5.0	—	92.7				
	RC	1		SAME AS CONCEPT 10A										25.0	1.3	1.1	153.4	6.2	3.5	5.0	.4	168.5				
	TOTAL	4		12,201						58.8	1852	39.3	-HC/FC -24 CM	75.2	12.7	4.8	204.7	96.6	37.7	20.0	4.0	363.0	12,201	98.1	0.15	0.40
10D	F	1	23.7	1670	7.6	2.0	2.7	0.2 (CREW) 2.2 (EXP)	1.1	15.8	607 9	13.4 0.1	-24 CM -EU25	25.0	4.3	1.3	17.1	14.4 5.7	7.8 1.2	5.0	1.4	52.6	1670	29.3	0.37	0.46
	BLH	1		SAME AS CONCEPT 10										15.3	—	1.0	17.0	7.1	7.1	5.0	—	36.2				
	CORE/ A/L	1		SAME AS CONCEPT 10										9.9	—	1.0	16.9	53.4	17.4	5.0	—	92.7				
	RC	1		SAME AS CONCEPT 10A										25.0	4.3	1.1	153.4	6.2	3.5	5.0	.4	168.5				
	TOTAL	4		11,296						57.0	1772	34.0	-HC/FC -EU25 -24 CM	75.2	5.6	4.4	204.4	86.8	37.0	20.0	1.8	350.0	11,246	91.0	0.16	0.37

[1] BASED ON INSIDE USABLE DIAMETER. EXCLUDES COMMON SUBSYSTEMS COMPARTMENT, AIRLOCK. [2] ASSUMES 90-DAY RESUPPLY [3] EXCLUDES AIRLOCK

Figure I-32. Concept No. 10, Sheet 5

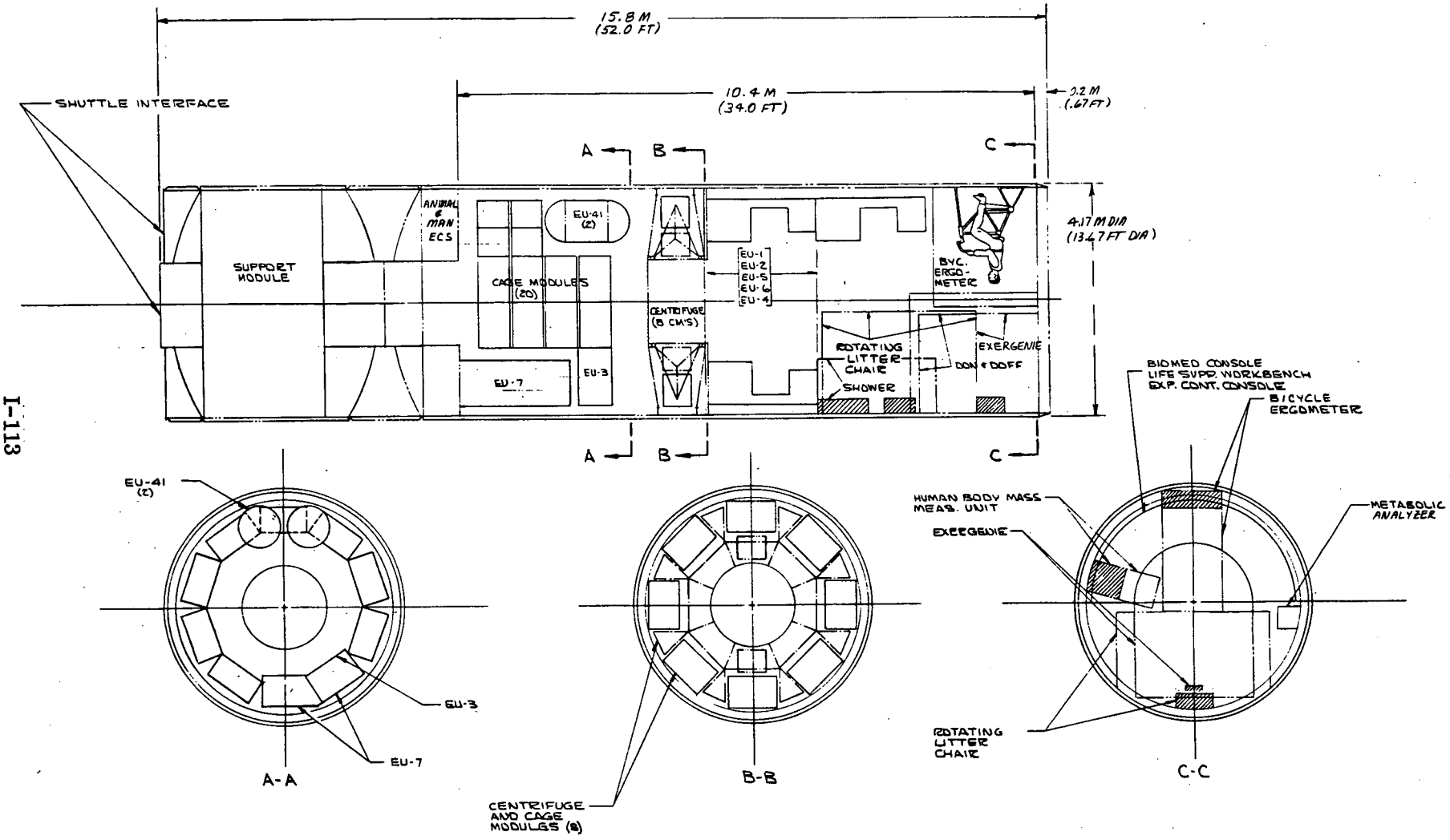


Figure I-33. Midi-30 Payload Design Analysis (Shuttle)

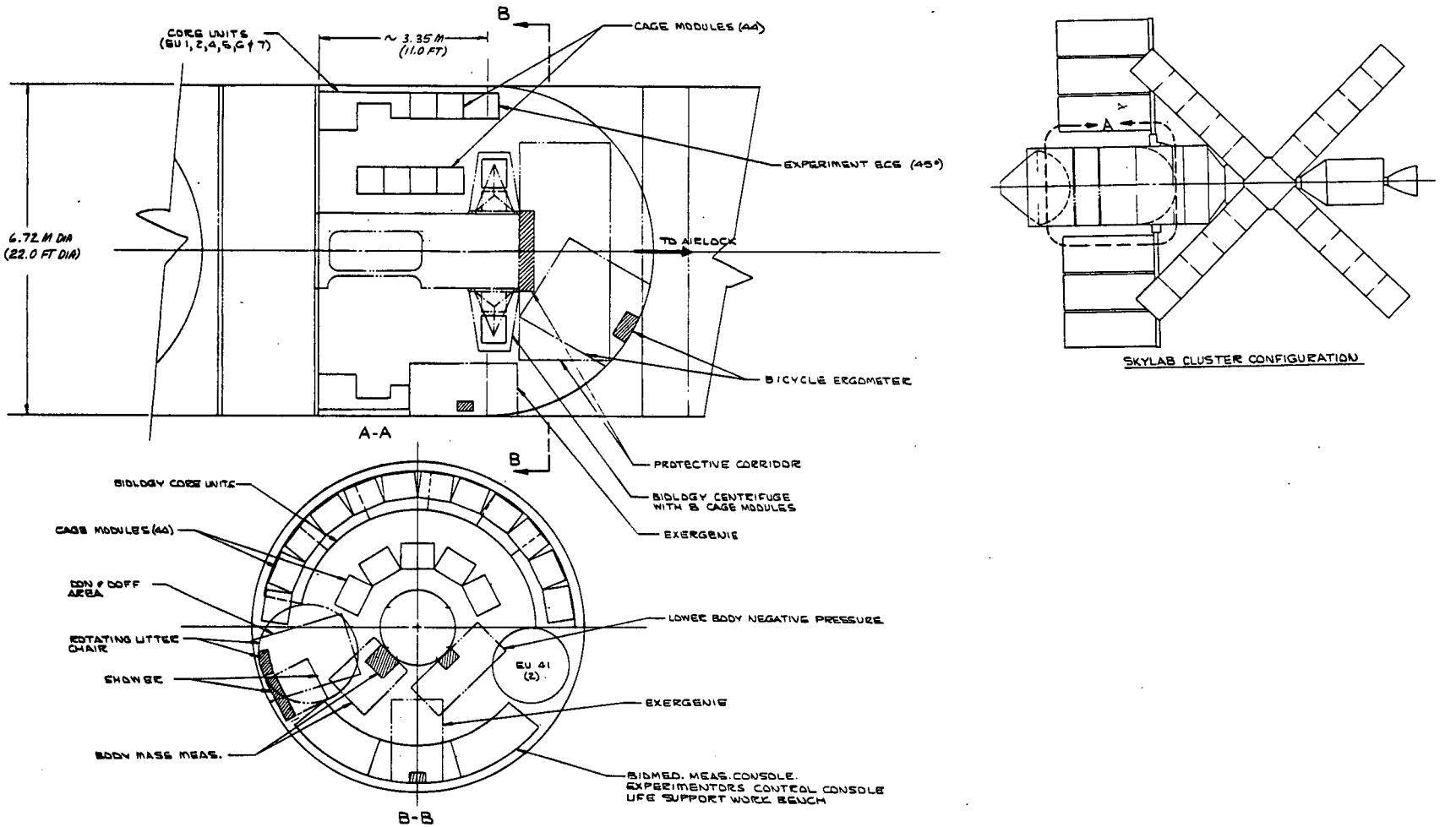


Figure I-34. Midi-56 Payload Design Analysis (Skylab)

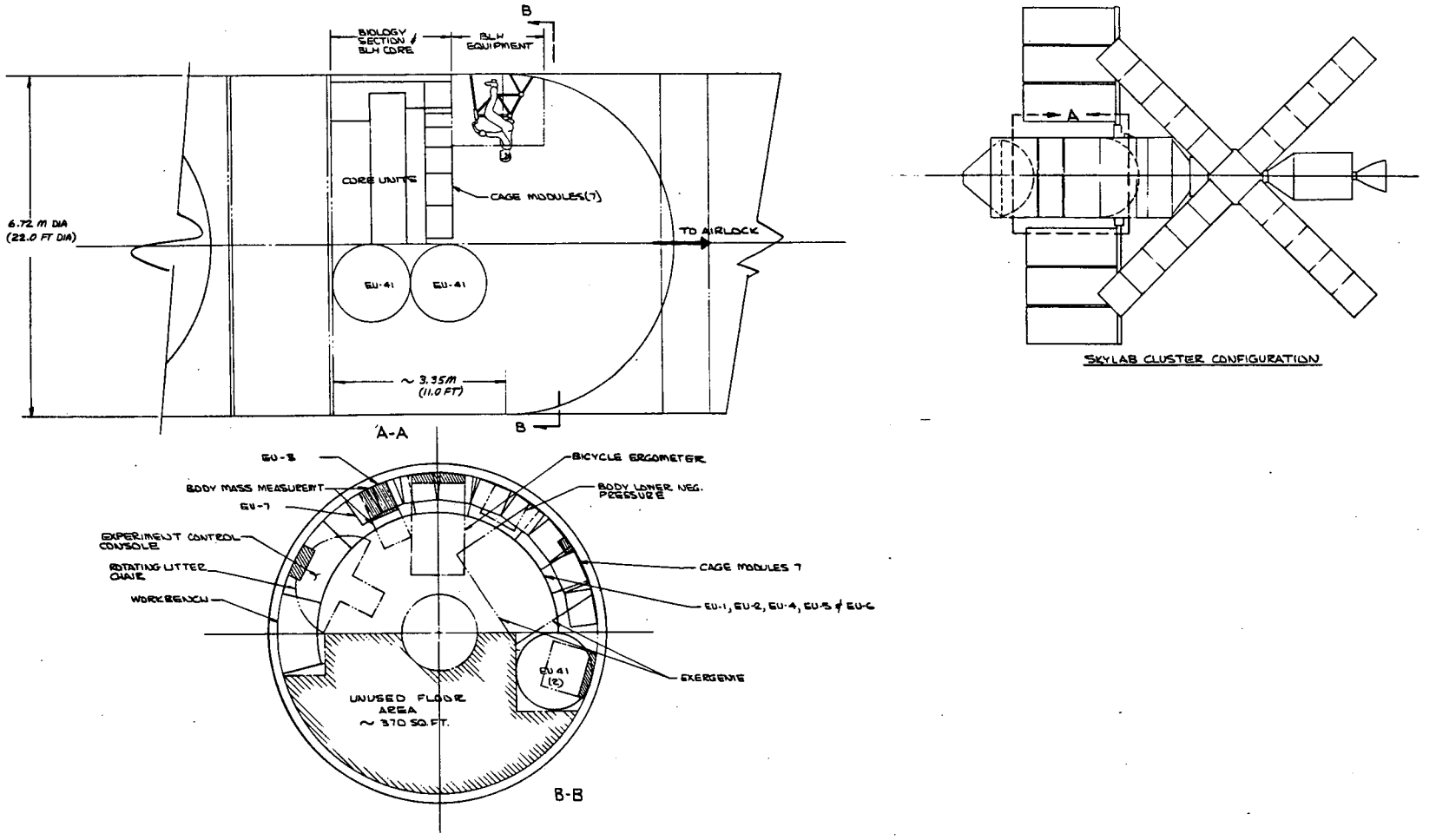


Figure I-35. Mini-56 Payload Design Analysis (Skylab)

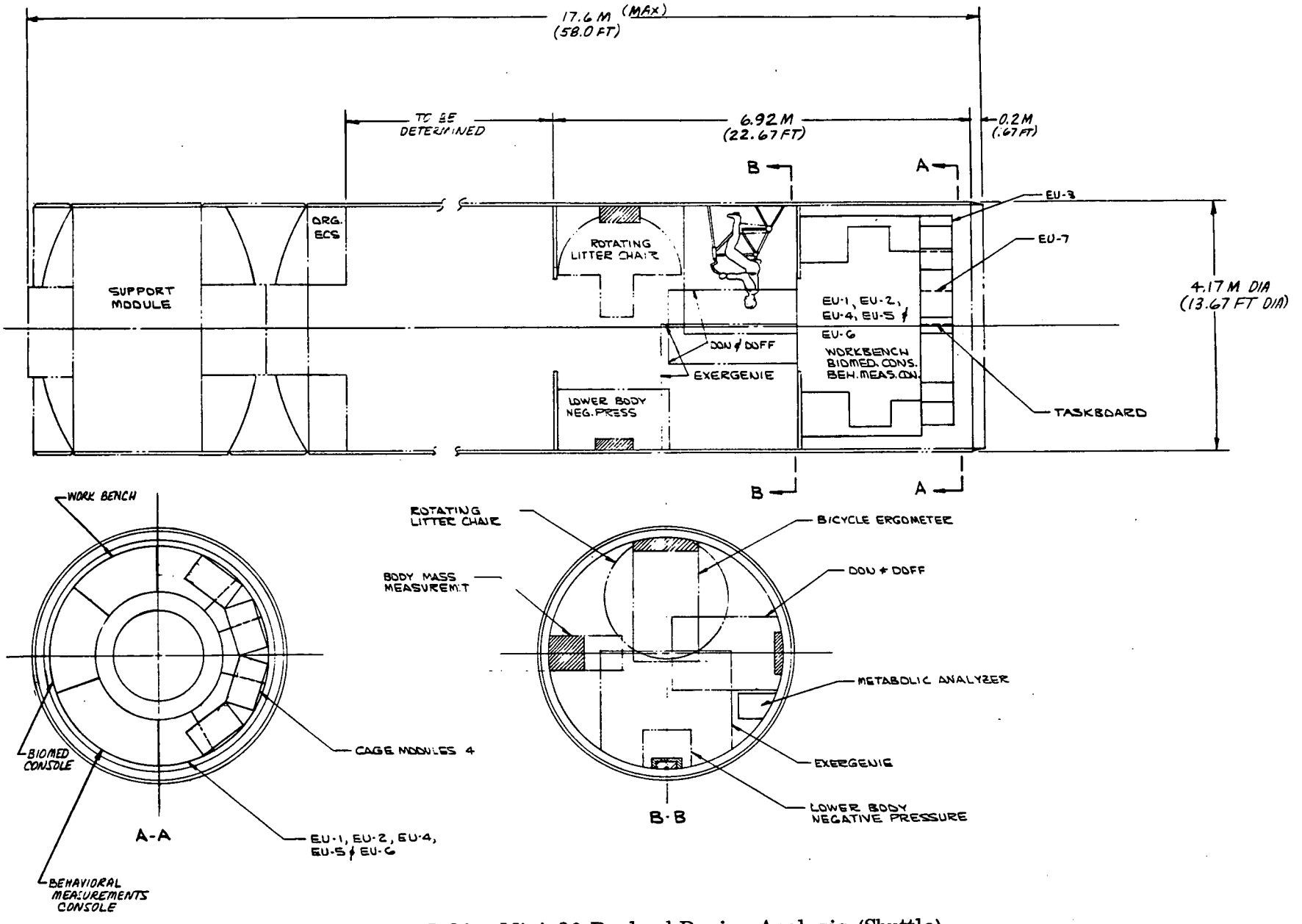


Figure I-36. Mini-30 Payload Design Analysis (Shuttle)

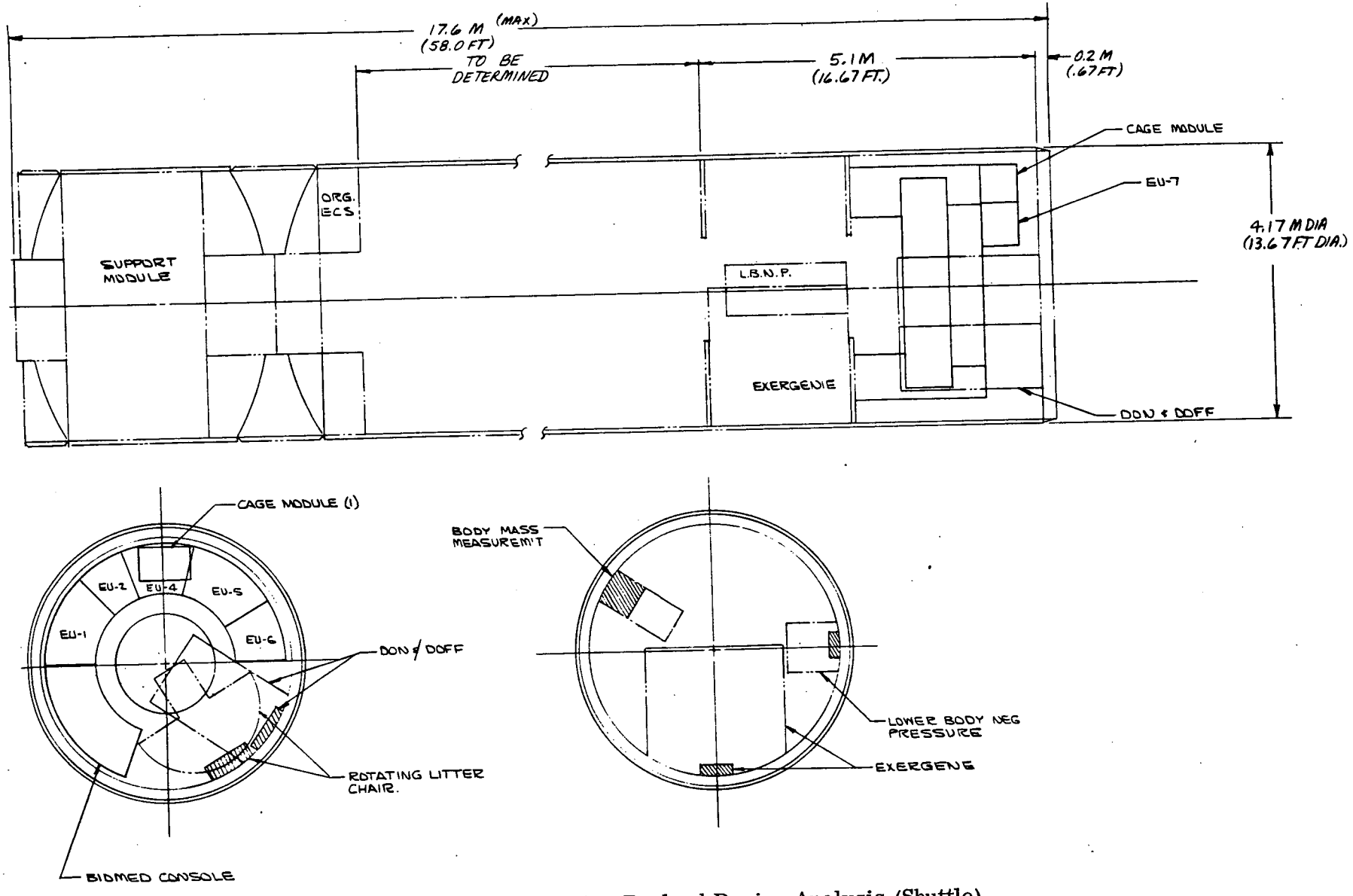


Figure I-37. Mini-7 Payload Design Analysis (Shuttle)

I.4 EXTERNAL CENTRIFUGES FOR MAXI MAX

Figures I-40, I-41, and I-42 are layouts of the FC, HC, and RC centrifuges. As a result of NASA direction at the close of first generation layout studies, the FC and HC were combined into a single centrifuge and identified as the RC. This RC was used for the second generation layouts for Maxi Max.

The RC unit is 3.68 m (12.0 ft) outside diameter and 19.45 m (58.0 ft) in over all length. It houses biology and MSI research equipment. The biology equipment consists of 48 stationary cage modules, 2 mobile cage modules, 1 primate sphere, 2 macaque cylinders, and 3 EU 042/071-2 holding support units.

For MSI,habitability equipment (EU-120) is installed at section D-D to provide approximately 0.30 g acceleration. At section E-E are the Behavioral Measurements units, and a walking and experiment area within a one g field.

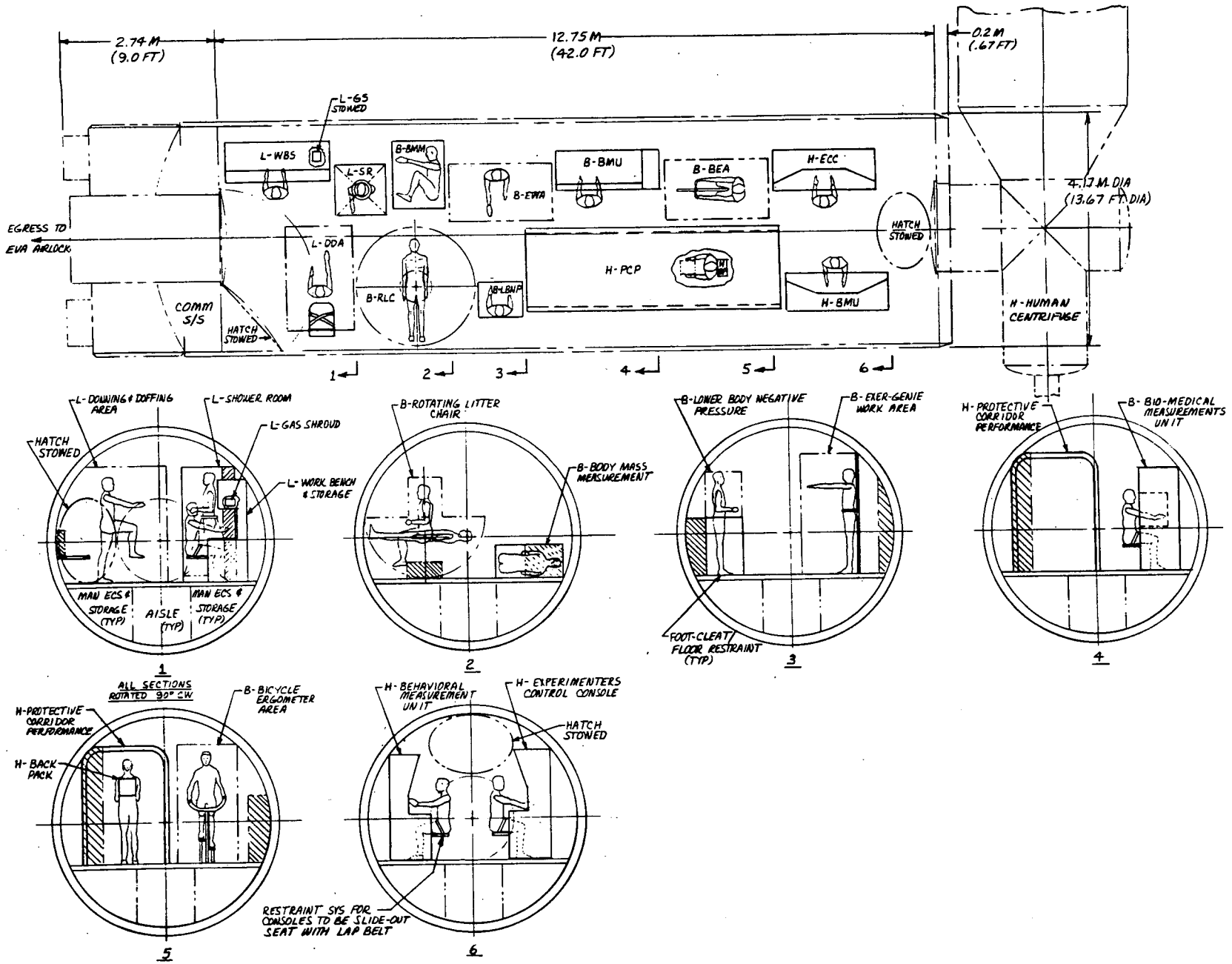


Figure I-38. BLH Module Long Floor Min. Time Share Layout (Data Point)

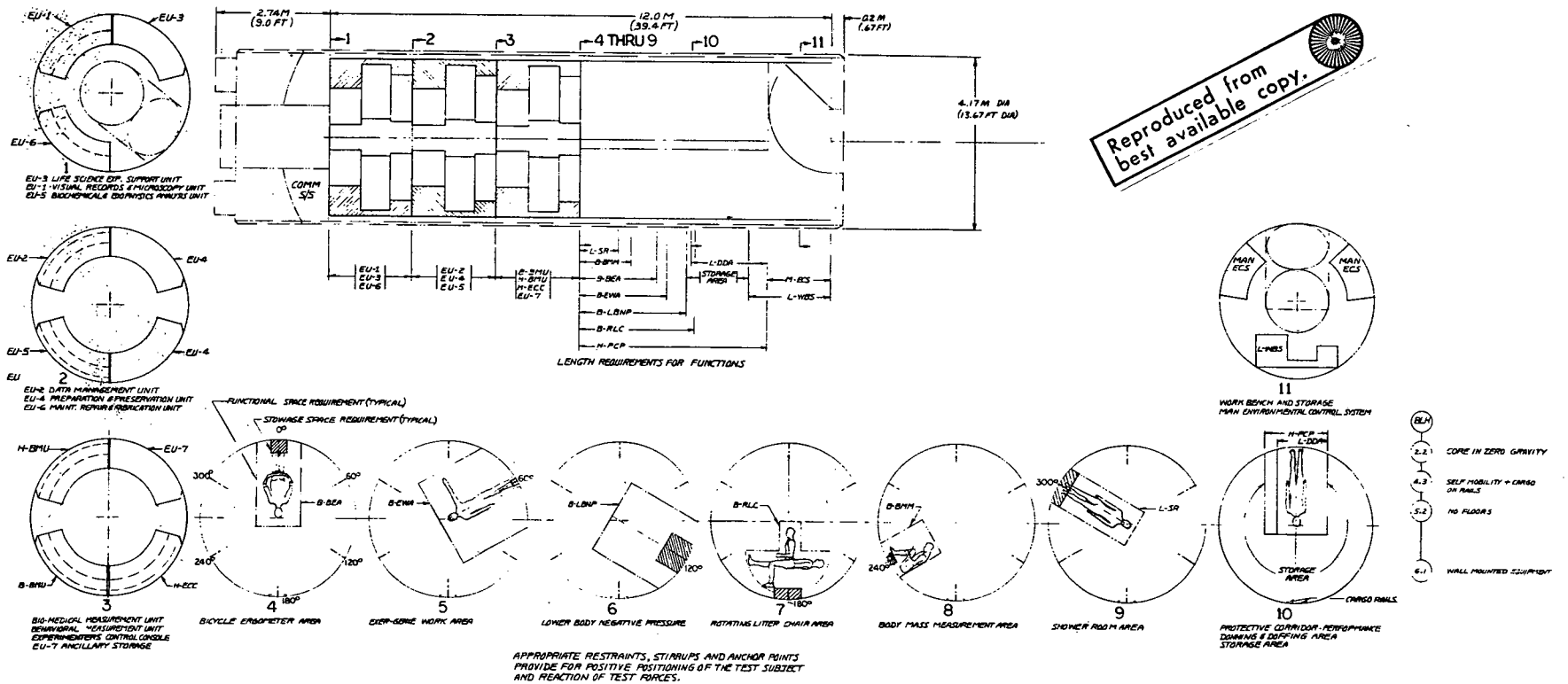


Figure I-39. BLH Module with CORE

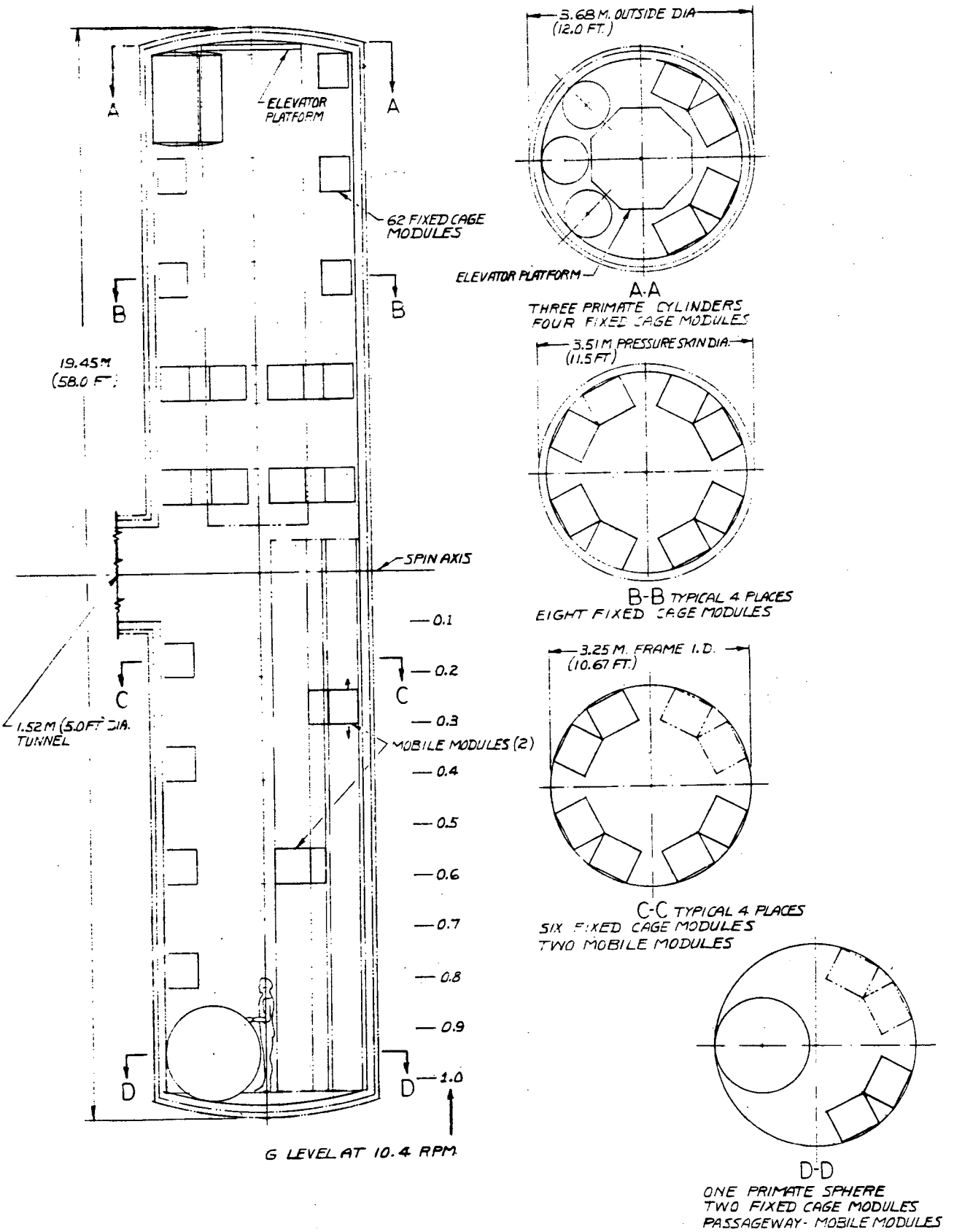


Figure I-40. FC Biology Research Centrifuge

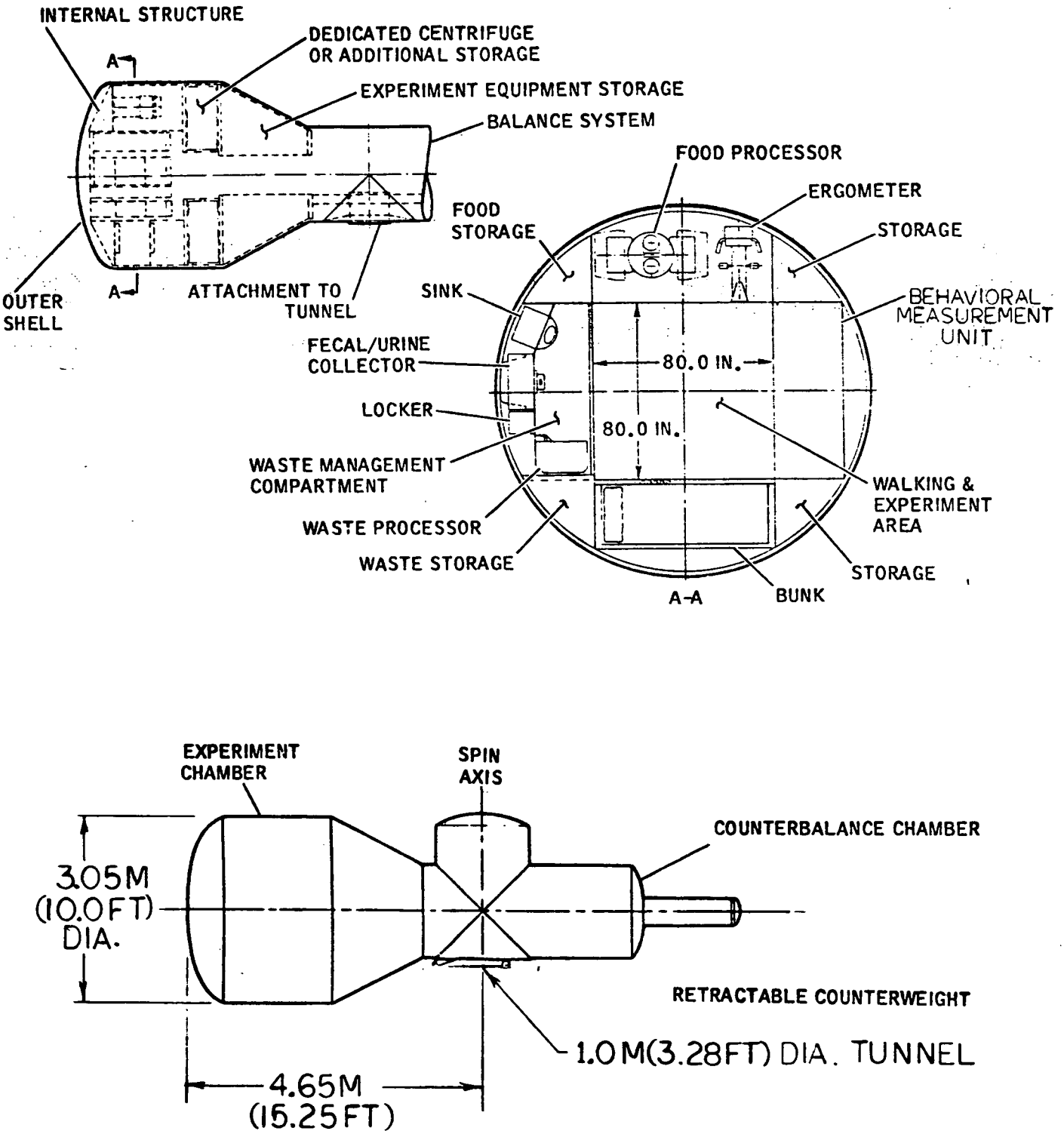


Figure I-41. HC Human Research Centrifuge

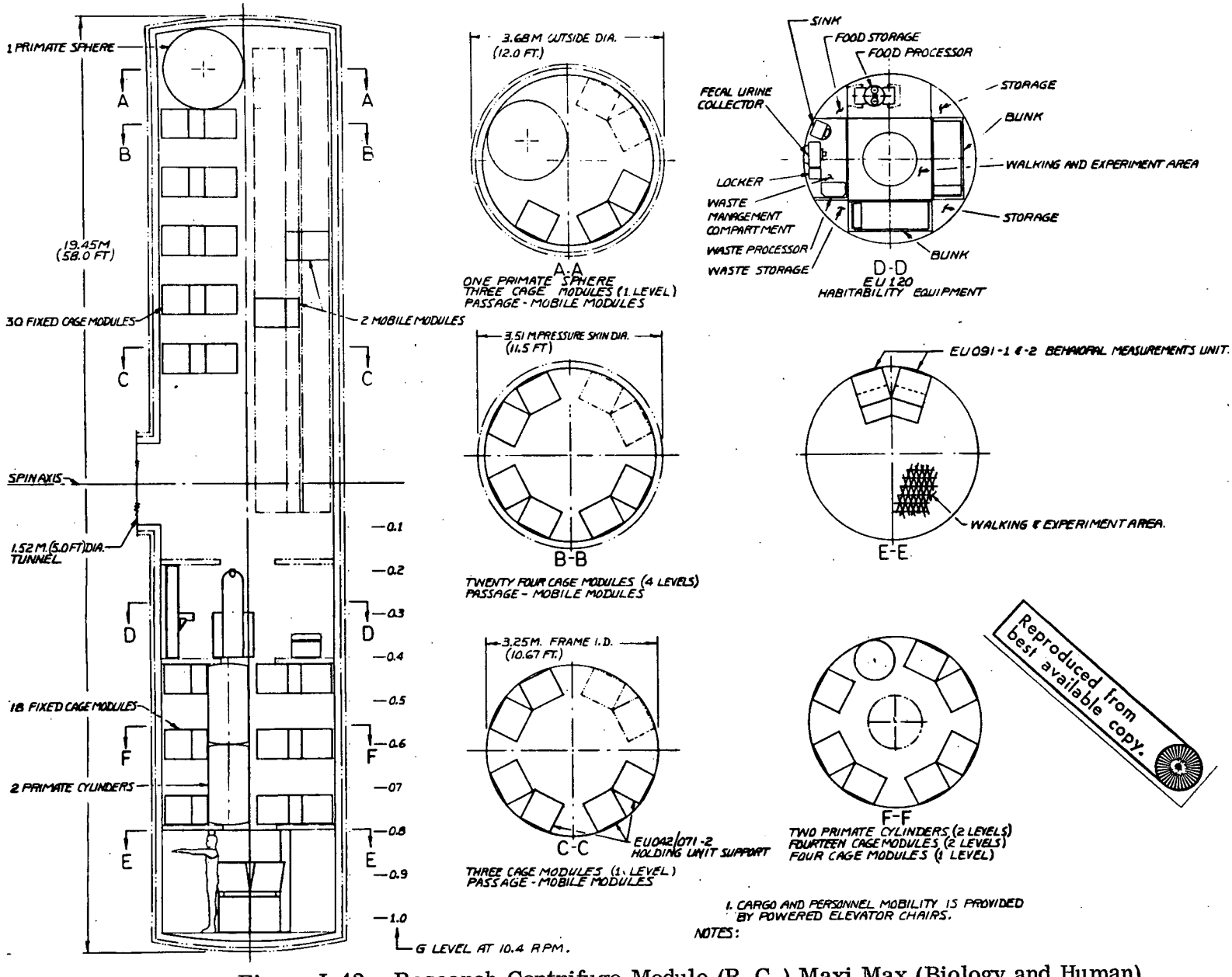


Figure I-42. Research Centrifuge Module (R. C.) Maxi Max (Biology and Human)

I. 5 MIDI-30 PAYLOAD

The contents of the Midi-30 payload are illustrated in Figures I-43 and I-44. All other payloads were selected as baselines and are presented in Volume II of this report.

I. 6 LONGITUDINAL FLOOR ARRANGEMENT

Equipment arrangements were studied for the "long floors" configurations and are shown in Views A through F of Figure I-45. Views B and C are configurations that were carried into the second generation layouts, and subsequently used in the baselines. Views A, D, E, and F are configurations which proved to be undesirable due to the restricted aisle space available for emergency egress or equipment transfer.

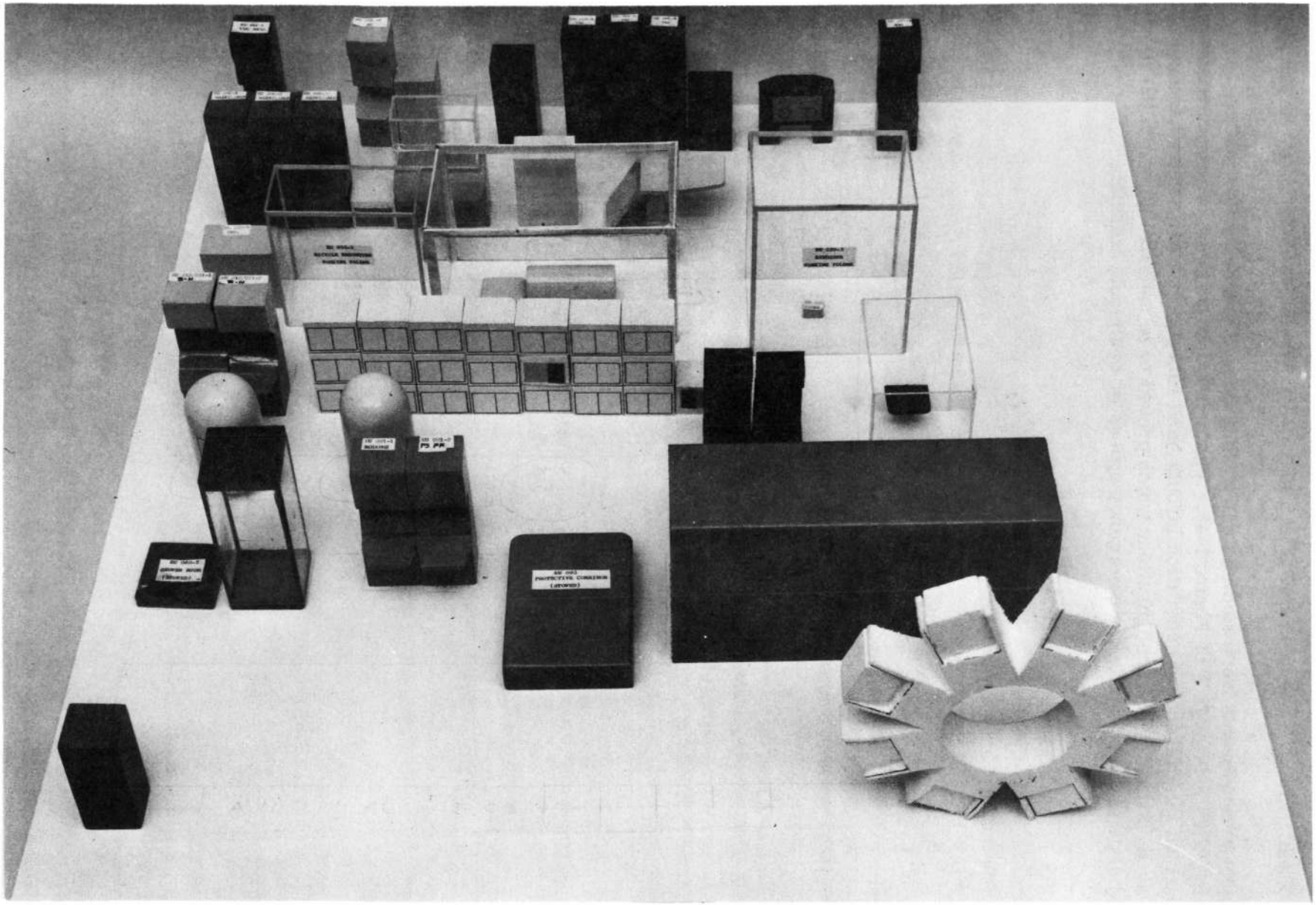
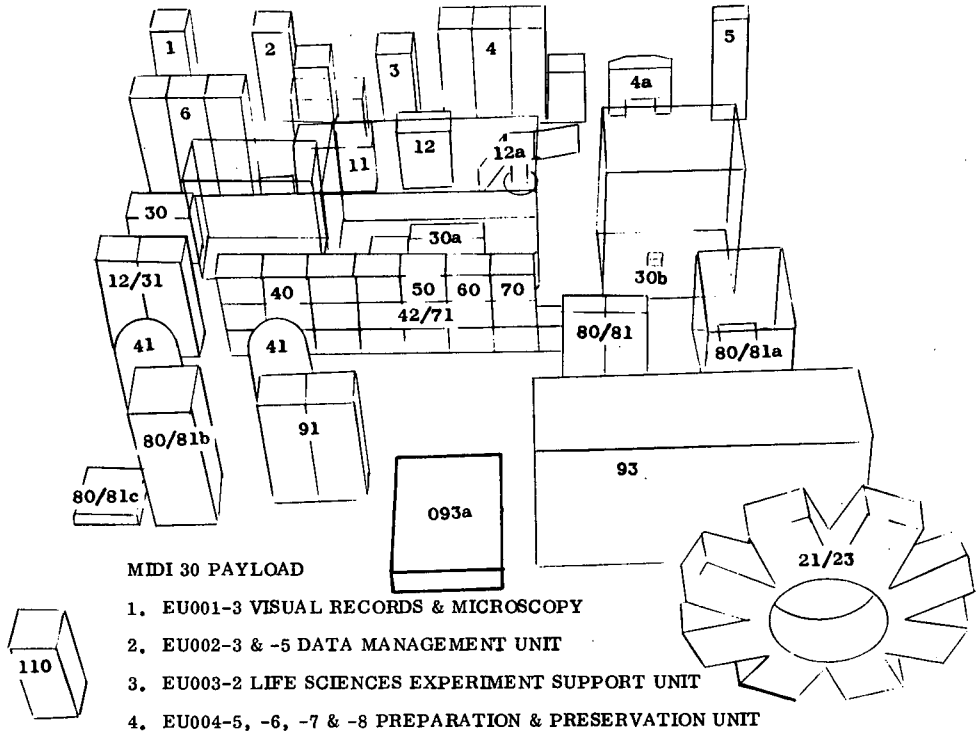


Figure I-43. Midi-30 Payload Contents



MIDI 30 PAYLOAD

1. EU001-3 VISUAL RECORDS & MICROSCOPY
2. EU002-3 & -5 DATA MANAGEMENT UNIT
3. EU003-2 LIFE SCIENCES EXPERIMENT SUPPORT UNIT
4. EU004-5, -6, -7 & -8 PREPARATION & PRESERVATION UNIT

4a. EU004-13 LAMINAR FLOW BENCH

5. EU005-3 BIOCHEMICAL & BIOPHYSICS ANALYSIS UNIT
6. EU006-2, -3 & -4 MAINTENANCE REPAIR AND FABRICATION UNIT
11. EU011-1 & -2 REMOTE MANIPULATOR
12. EU012-1 BODY MASS MEASUREMENT

12a. EU012-2 ROTATING LITTER CHAIR

12/31. EU012/031-1 & -2 BIOMEDICAL MAN-SYSTEM INTEGRATION RESEARCH SUPPORT UNIT

21/23. EU021/023 INTERNAL CENTRIFUGE

30. EU030-1 BICYCLE ERGOMETER

30a. EU030-2 LOWER BODY NEGATIVE PRESSURE

30b. EU030-3 EXERGENIE

40. EU040 CAGE MODULE VERTEBRATE (16)

41. EU041-1 PRIMATE CYLINDER (2)

42/71. EU042/071-3 HOLDING UNIT RESEARCH SUPPORT EQUIPMENT

50. EU050 CAGE MODULE PLANT (8)
60. EU060 CAGE MODULE CELL & TISSUE (2)
70. EU070 CAGE MODULE INVERTEBRATE (2)

80/81. EU080/081-1 & -2 LIFE SUPPORT SUBSYSTEM TEST UNIT

80/81a. EU080/081-4 SPACE SUIT DONNING & DOFFING SEAT

80/81b. EU080/081-5 WHOLE BODY SHOWER (DEPLOYED)

80/81c. EU080/081-5 WHOLE BODY SHOWER (STOWED)

91. EU091-1 & -2 BEHAVIORAL MEASUREMENTS UNIT

93. EU093-1 MOBILITY UNIT DAMAGE PROOF (DEPLOYED)

93a. EU093-1 MOBILITY UNIT DAMAGE PROOF (STOWED)

110. EU110-2 ANIMAL ENVIRONMENTAL CONTROL SYSTEM

Figure I-44. Midi-30 Payload Equipment Layout

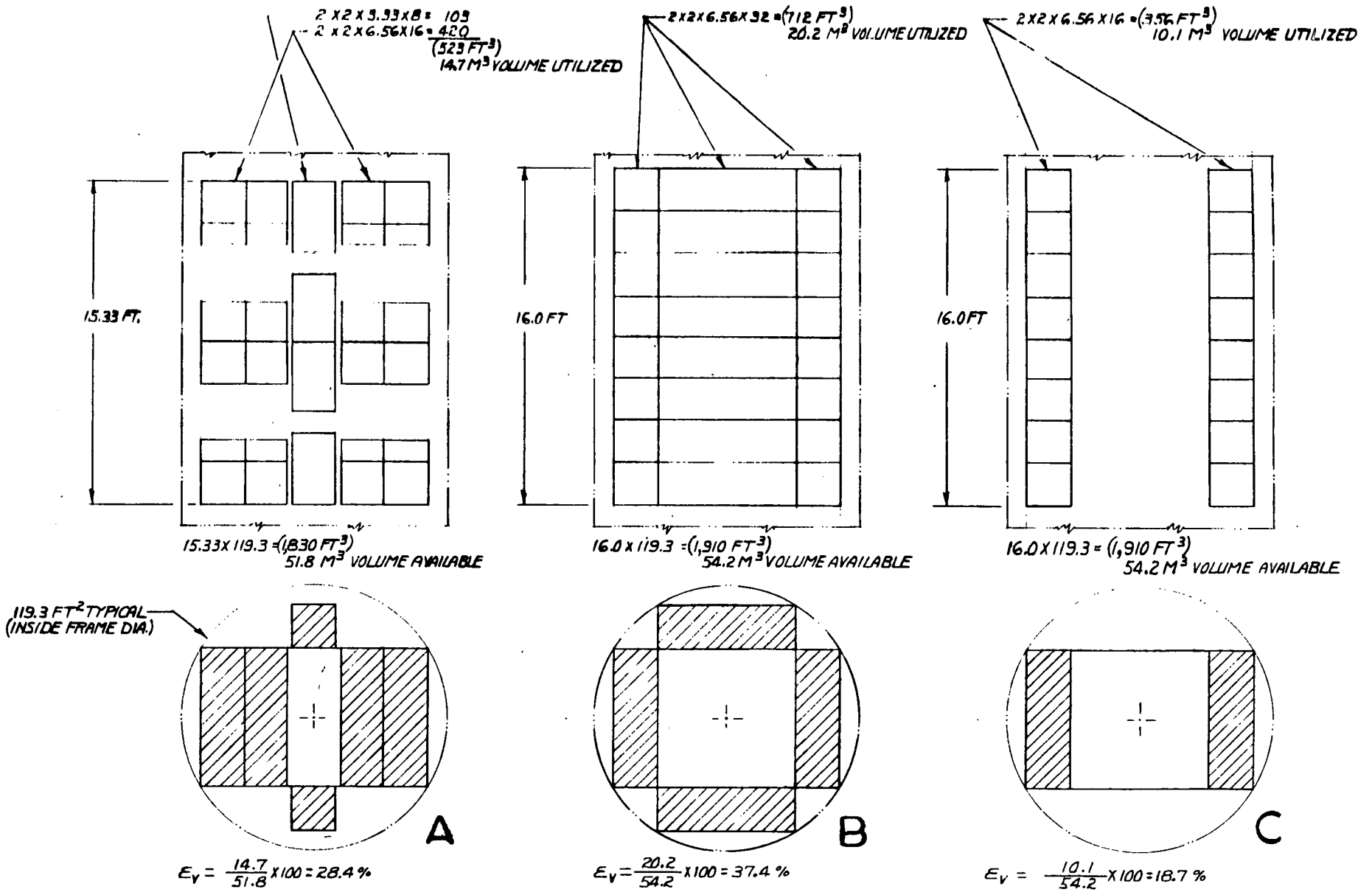


Figure I-45. Volumetric Efficiency Sensitivity vs General Arrangement (Sheet 1)

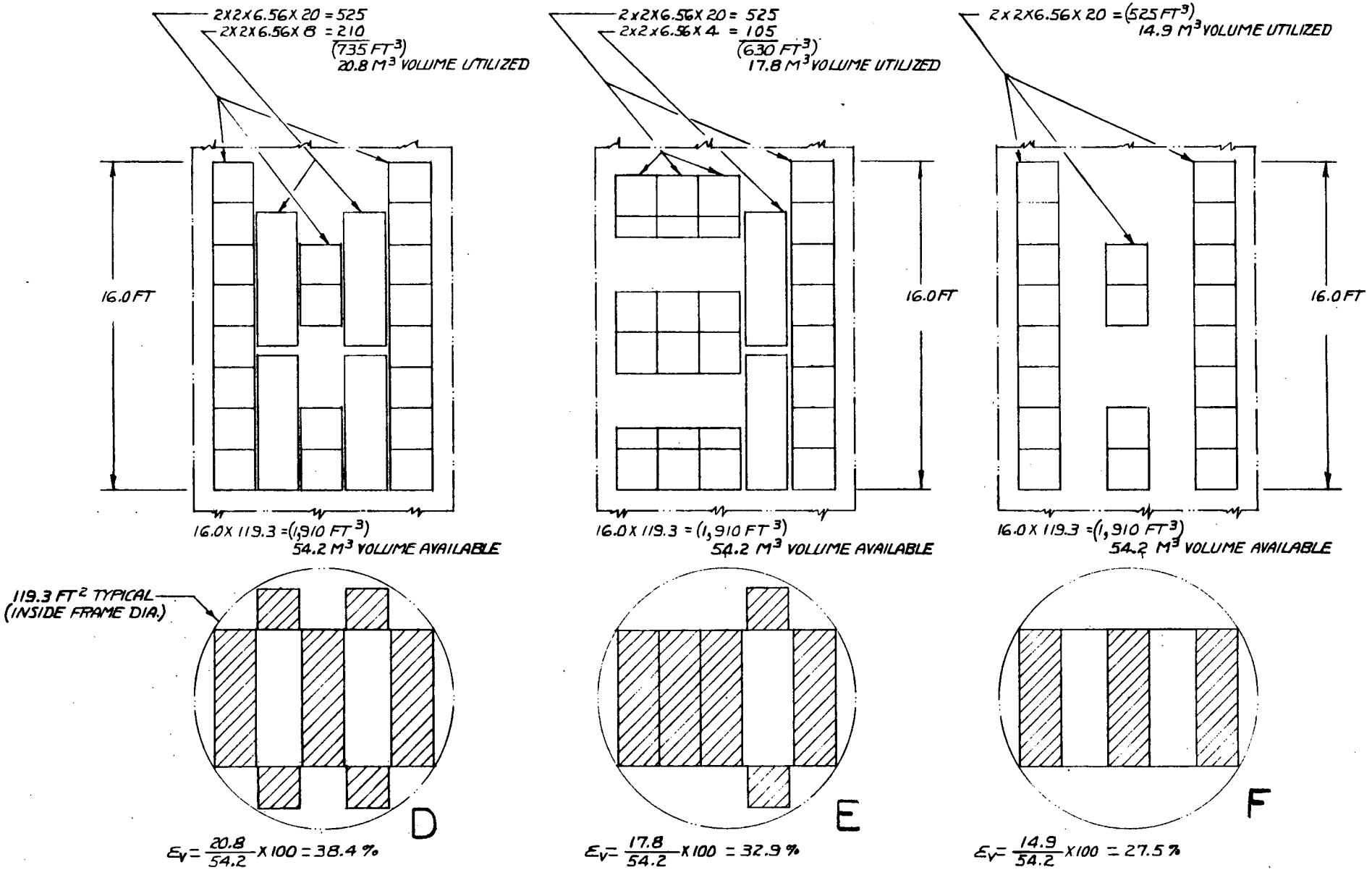


Figure I-45. Volumetric Efficiency Sensitivity vs General Arrangement (Sheet 2)

I. 7 NON-BASELINE SECOND GENERATION LAYOUTS

This section discusses the second generation payload layouts that were not selected as baselines.

I. 7. 1 MAXI MAX LAYOUT DESCRIPTIONS. Figure I-46 shows an F Module layout for Maxi Max utilizing the longitudinal floors concept. The equipment is arranged in a linear arrangement. The animal ECS modules are shown stored above the floor. Two macaque cylinders, the primate sphere, and the radiobiology unit are shown stowed below the floor. The module length required to house this configuration is approximately 11 meters (36-1/2 ft).

A companion module to the configuration shown in Figure I-46 is shown in Figure I-47 This is the BLH module Maxi Max no floors configuration. The overall usable space required is approximately 26 ft and, the design utilizes a 0.9 meter sliding hatch. Shown at the extreme top of the photo is the protective corridor (EU-093) in the stowed position. Other equipment shown in this layout is the rotating litter chair, the lower body negative pressure unit next, the bicycle ergometer, and the body mass measurement unit. The rectangular thin block to the right and above the two consoles is the life support and protective systems whole body shower unit in the stowed position. Just below it are the two life support and protective system consoles. Other modules shown are the biomedicine measurement units, and MSI behavioral measurement units. The module to the extreme right, with the plastic box above, is the remote manipulation unit, and the dark cylinder below, is the common subsystem portion of the CM-4. This unit would incorporate mobility aids in the form of porches below the two life support and protective systems consoles. In the biomedical area, small local floors would be installed for foot restraints for use by the test conductor. Man's orientation in this configuration, in the lower portion of the unit would be parallel to the axis, and in the upper portion for biomedical functions, man's body would be radial or normal to the axis of the LS-RAM.

Figures I-48 and I-49 show the Maxi Max payload BLH Module longitudinal floors configuration. The photographs are self-explanatory, they contain biomedical, MSI and LSPS research equipment. This is a long floors configuration, and the mobility system would be pressure walking or guided soaring. Figure I-49 shows the protective corridor in the deployed position.

A study was made to investigate placing the CORE in the BLH Module, the results are shown in Figures I-50 and I-51. Figure I-50 is the F Module without the CORE (i.e. CORE in the BLH Module). Figure I-51 shows the BLH Module with all the CORE units installed. This unit would require an overall length of 33 ft.

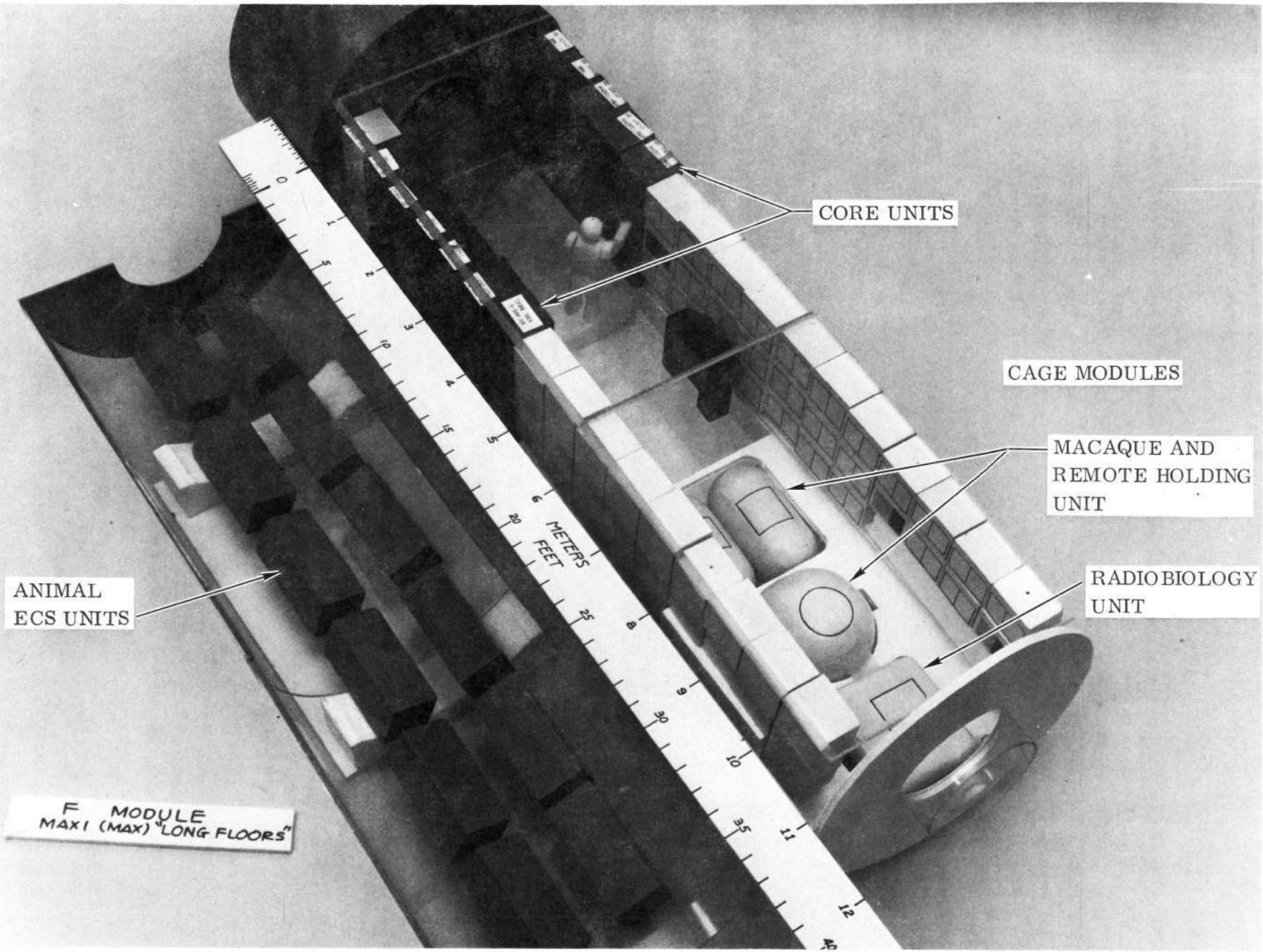


Figure I-46. F Module Maxi Max "Long Floors"

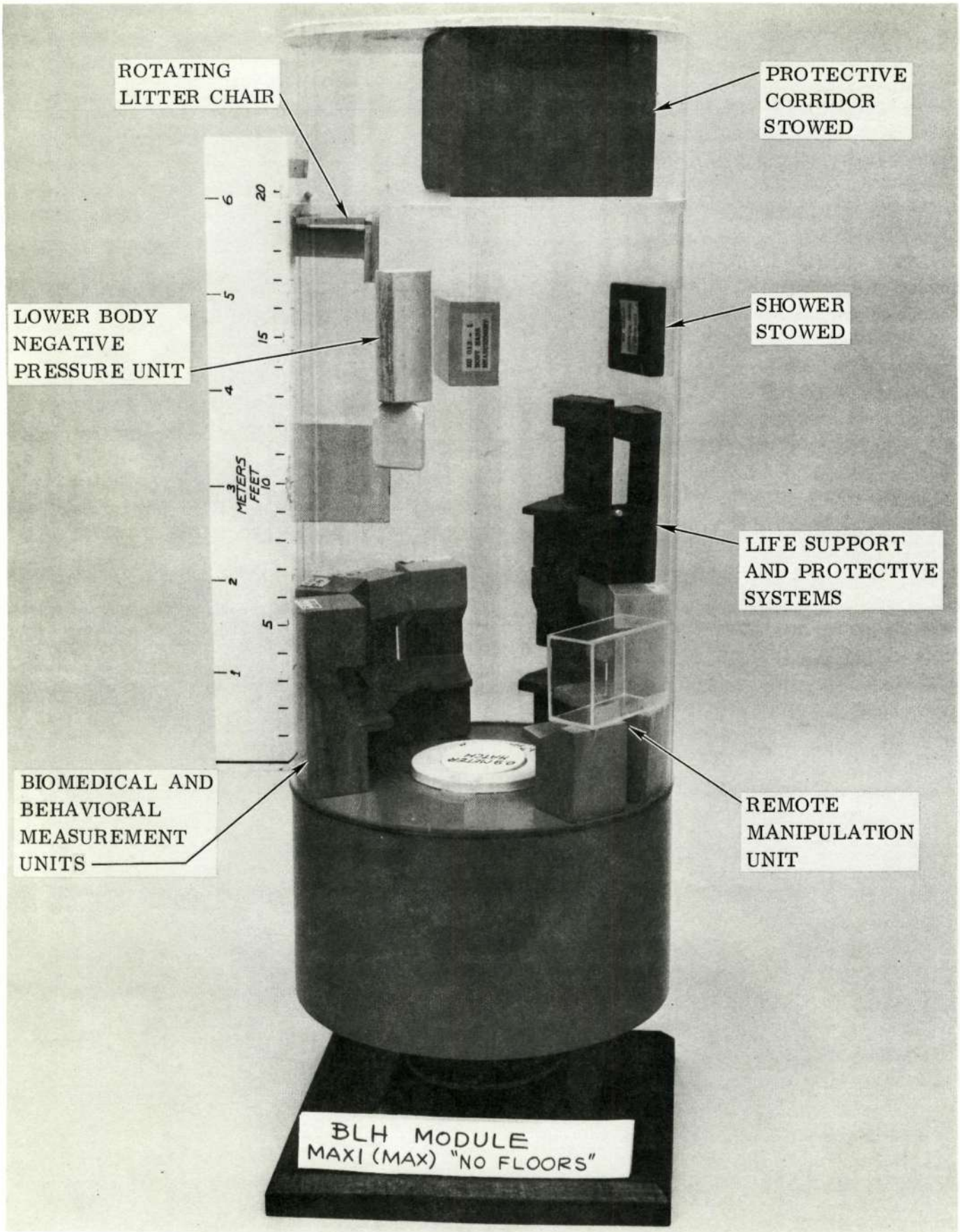


Figure I-47. BLH Module Maxi Max "No Floors"

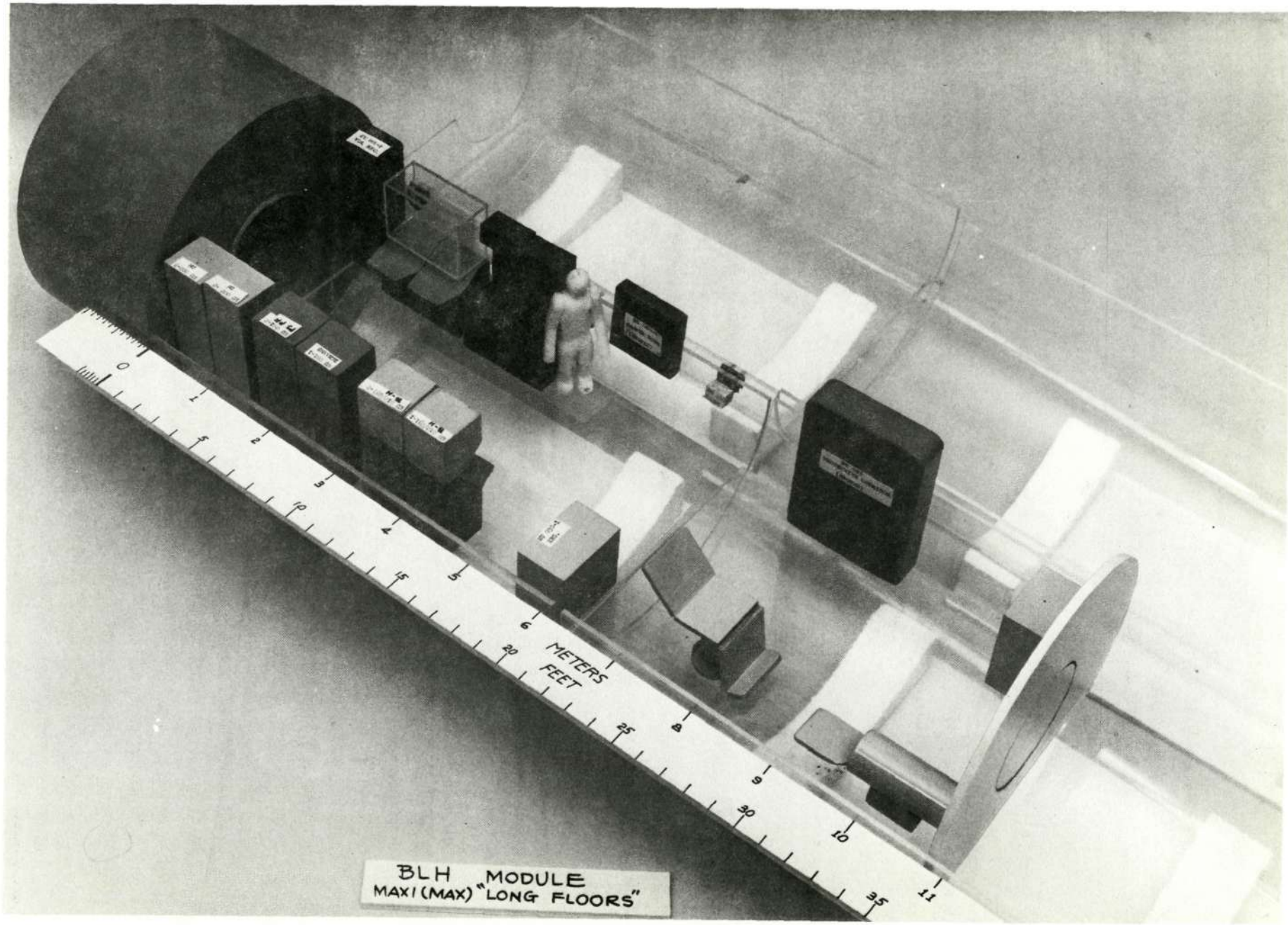


Figure I-48. BLH Module Maxi Max "Long Floors"

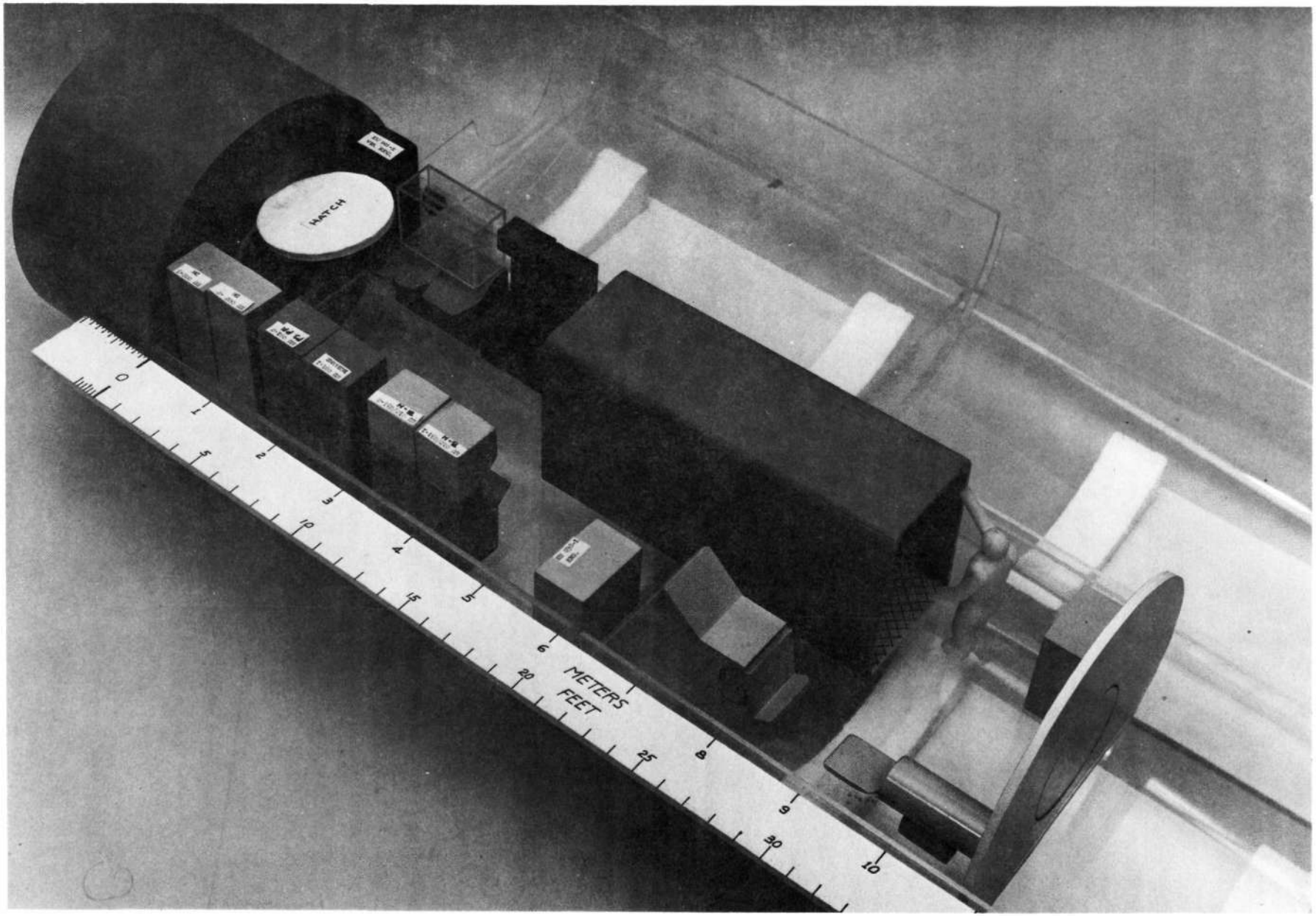


Figure I-49. BLH Module Maxi Max "Long Floors"

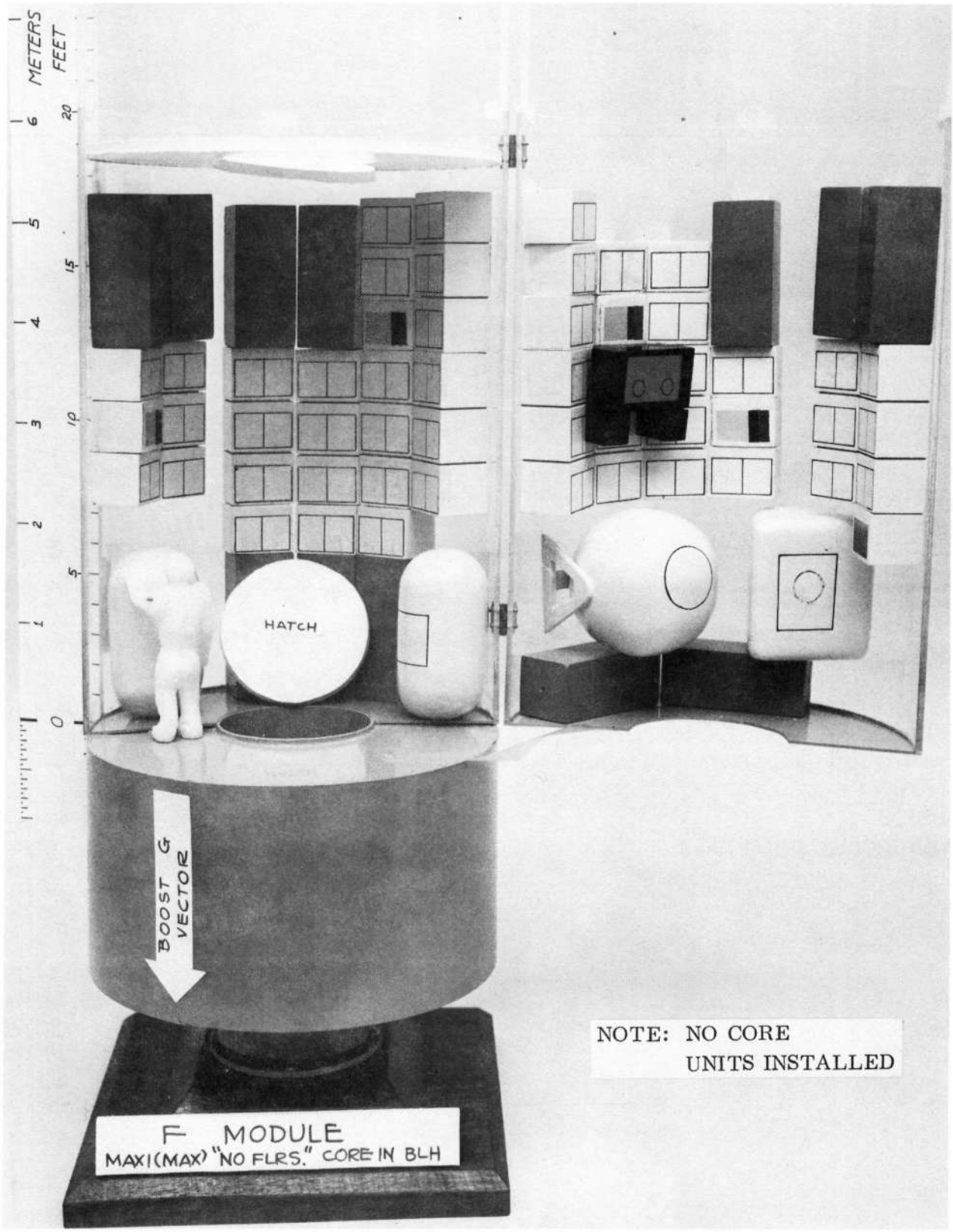


Figure I-50. F Module Maxi Max "No Floors" CORE in BLH

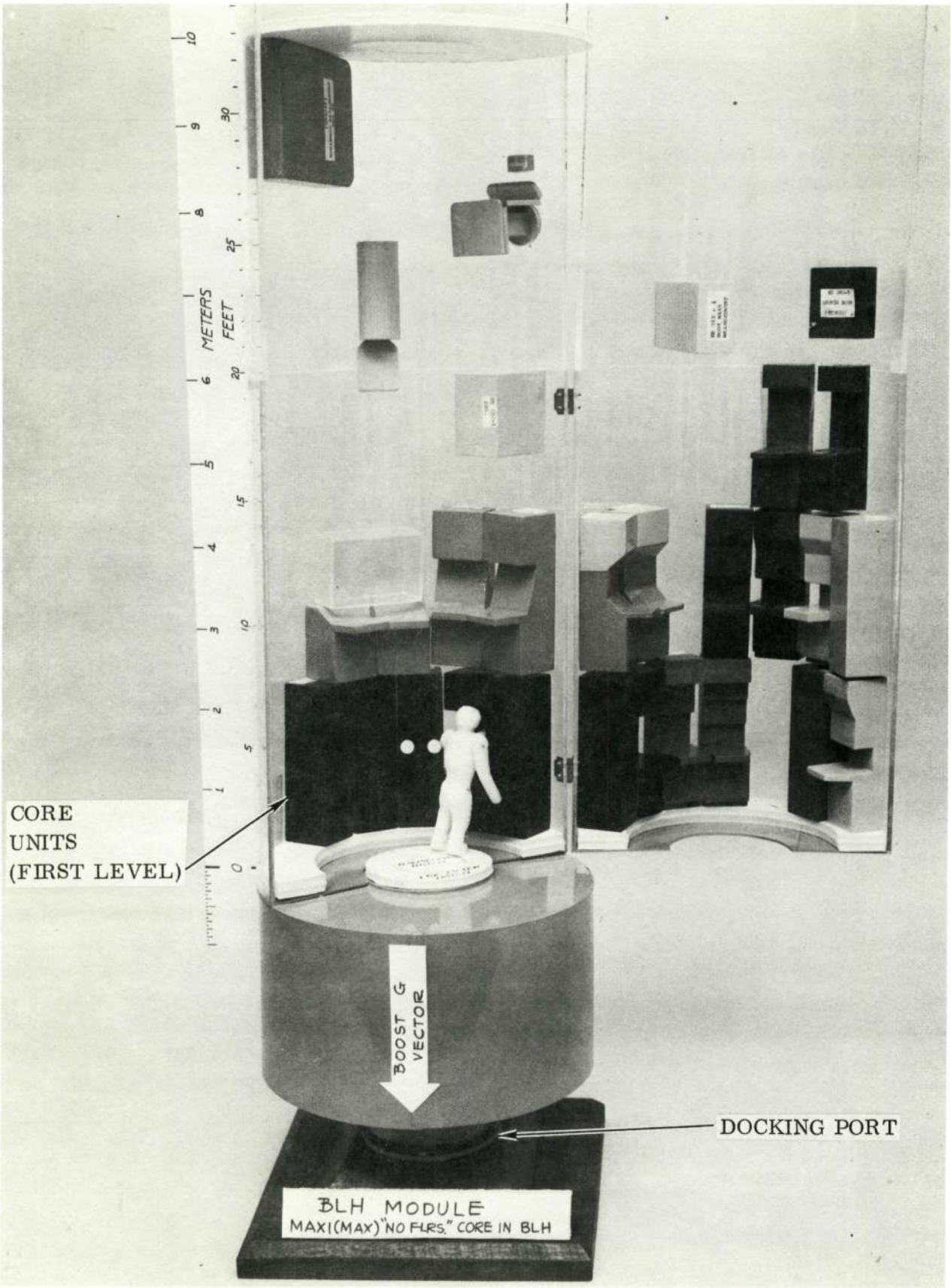


Figure I-51. BLH Module Maxi Max "No Floors" CORE in BLH

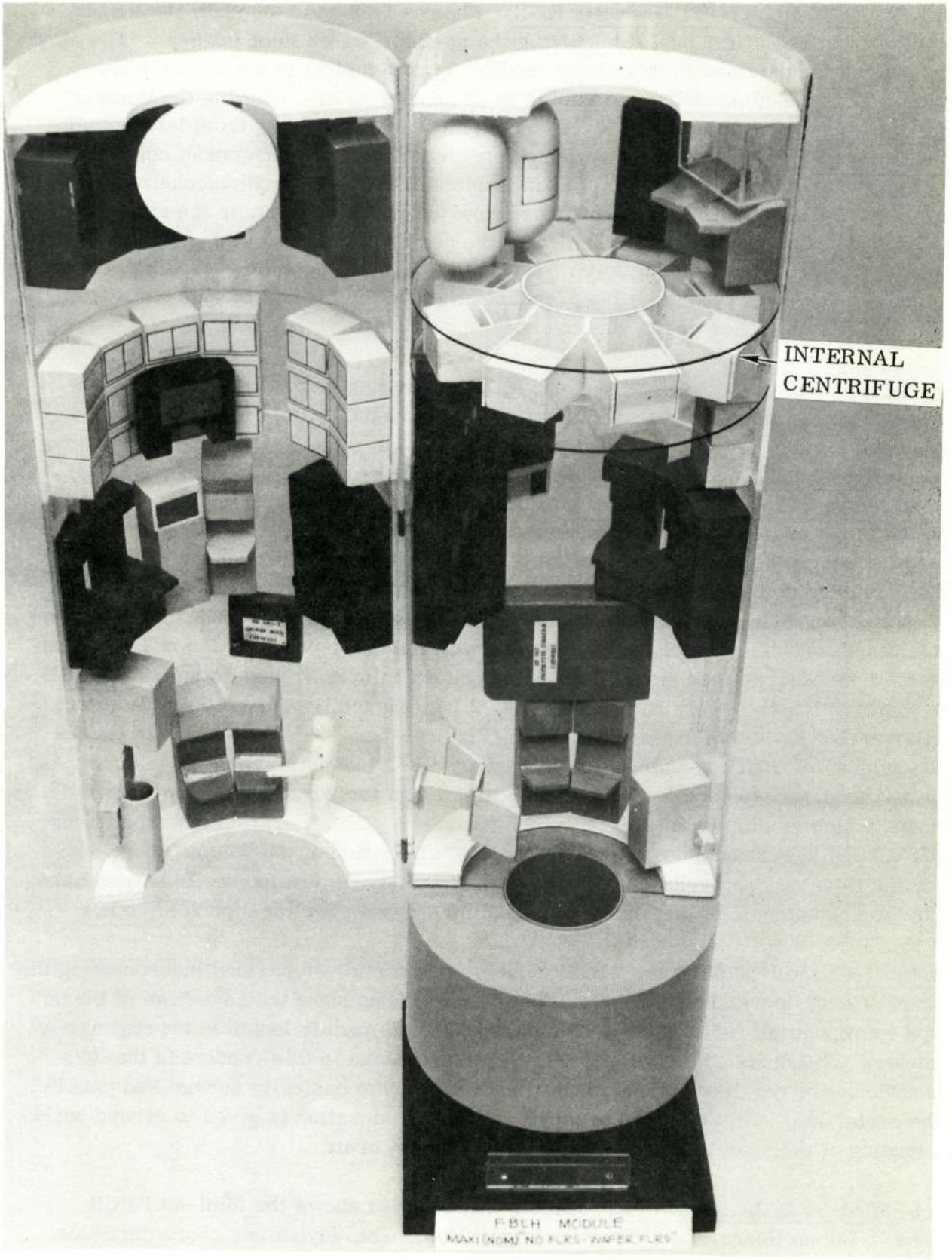


Figure I-52. FBLH Module Maxi Nom "No Floors - Wafer Floors"

I. 7. 2 MAXI NOM LAYOUT DESCRIPTION. Figures I-52 and I-53 show the FBLH Module for the Maxi Nom payload utilizing the no-floor/wafer floor concept. The Maxi Nom payload is contained in this single module for attachment to the modular Space Station. The 20 cage modules are visible in an annular array, showing the laminar flow bench in position. The next level of equipment down, reading from left to right, is the life support and protective systems consoles, the data management consoles, the preparation/preservation units, the analysis units, and the maintenance, repair and fabrication units. The large unit just below the annular array, in the right-hand section of the photograph, shows the protective corridor in the stowed position setting on top of two MSI measurement units. The left portion of the photo shows the bicycle ergometer, the lower body negative pressure, the two biomedical measurement consoles, the rotating litter chair, and the body mass measurement unit.

The FBLH Module for Maxi Nom payload utilizing the longitudinal floors concept is shown in Figure I-54. The layout is approximately 15 meters (49 ft) in length.

I. 7. 3 MIDI-30 LAYOUT DESCRIPTIONS. Figures I-55 and I-56 present the FBLH Module for the Midi-30 payload in a no floors/wafer floors configuration. This layout resulted in a module length of approximately 11 meters (36-1/2 ft). The unit was designed for use in the Shuttle Sortie mission and requires the research support module (RSM) rather than the normal common subsystem module portion of the CM-4. Figure I-57 is a photograph of a Midi-30 payload layout iteration. This second iteration eliminates the second wafer floor, and has only a wafer floor imposed by the bulkheads required for the internal centrifuge. An improvement in overall module length resulted with required length of only 10 meters (32-1/2 ft). Figure I-58 depicts a layout very similar to the one shown for the Maxi Nom (Figure I-54). The Midi-30, with its reduced number of CORE modules, can be packaged in a module of about 14 meters (46. 5 ft). Figures I-59 and I-60 depict a configuration for the Midi-30 long floors concept, which is actually an iteration of Figure I-58. This iteration made better use of the volume above and below the floor. Better utilization of the volume above and below the floor was an evolutionary outgrowth of the layout developed. This approach led to the development of the Maxi Nom baseline shown in Section 3 of Volume II.

Figures I-61 and I-62 show the FBLH module for the Midi-30 payload incorporating the concept of long floors and no floors. These photographs show the advantage of the no floors concept in terms of volume utilization. Overall module length is approximately 12 meters (37-1/2 ft). However, there is a disadvantage in this concept in that two orientations are required for the man. He must operate basically normal and parallel to the centerline. This imposes problems when consideration is given to ground build-up, loading of the module and Shuttle, and boosting to orbit.

I. 7. 4 MINI-30 LAYOUT DESCRIPTIONS. Figure I-63 shows the Mini-30 FBLH Module in the no floors/wafer floors configuration. This layout has characteristics similar to layouts previously described. There is 6. 62 meters (21. 72 ft) available for other disciplines in the unassigned area. This particular length is designed for a Shuttle Sortie mission.

I. 7. 5 MINI-7 LAYOUT DESCRIPTION. Figure I-64 shows this configuration designed for a Shuttle Sortie mission, with 8. 7 meters (28. 5 ft) available in the unassigned area.

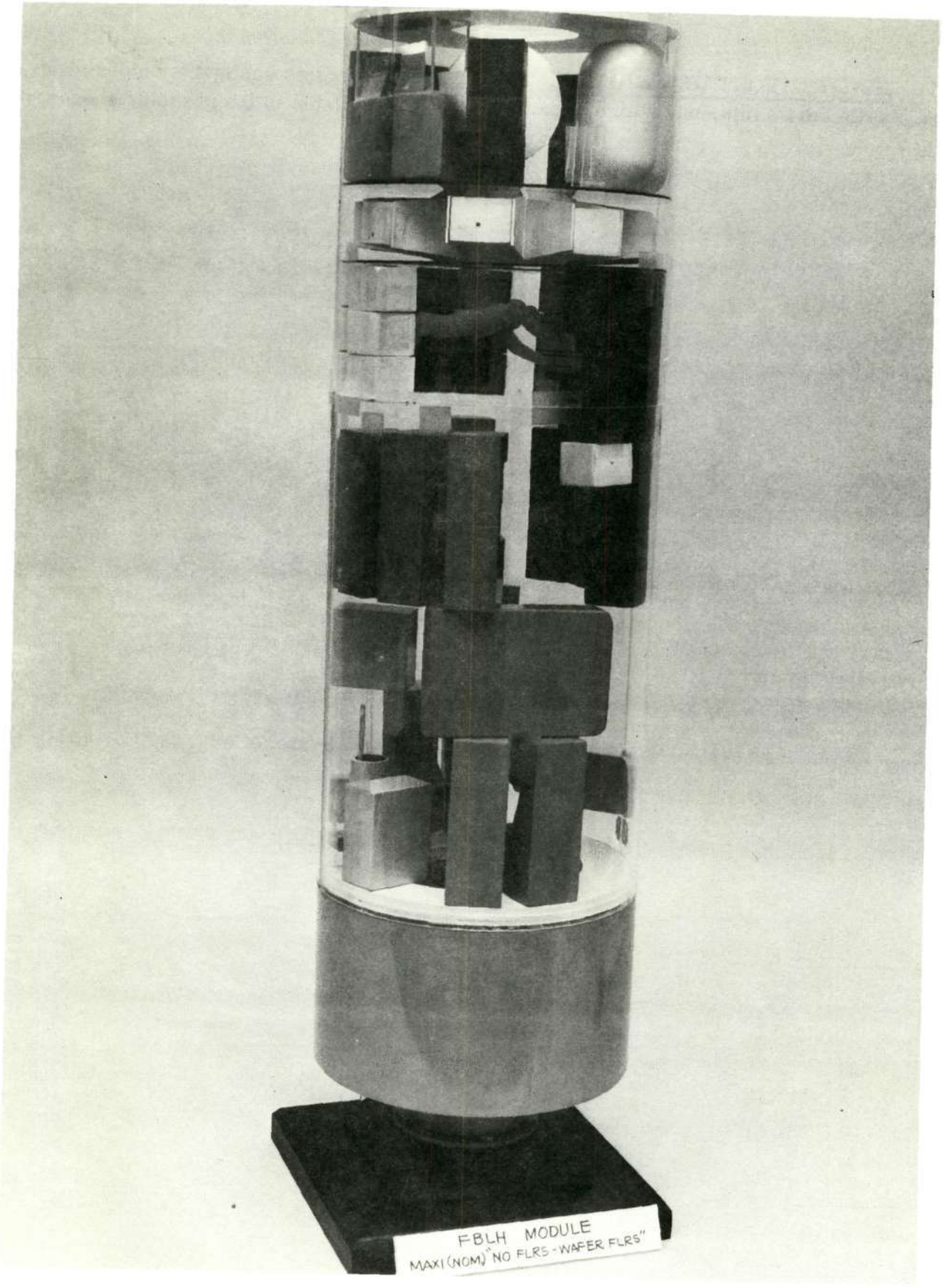


Figure I-53. FBLH Module Maxi Nom "No Floors - Wafer Floors"

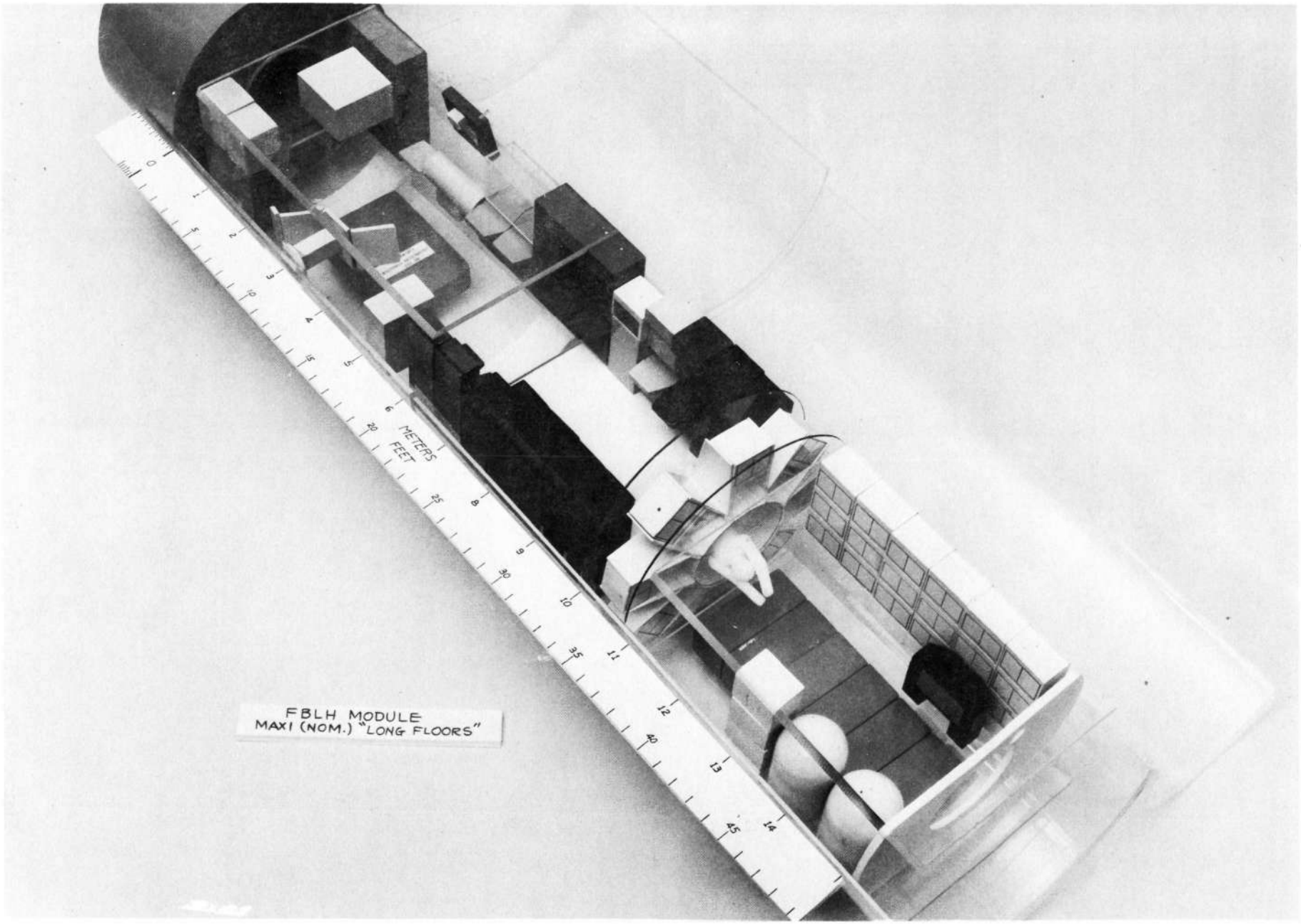


Figure I-54. FBLH Module Maxi Nom "Long Floors"

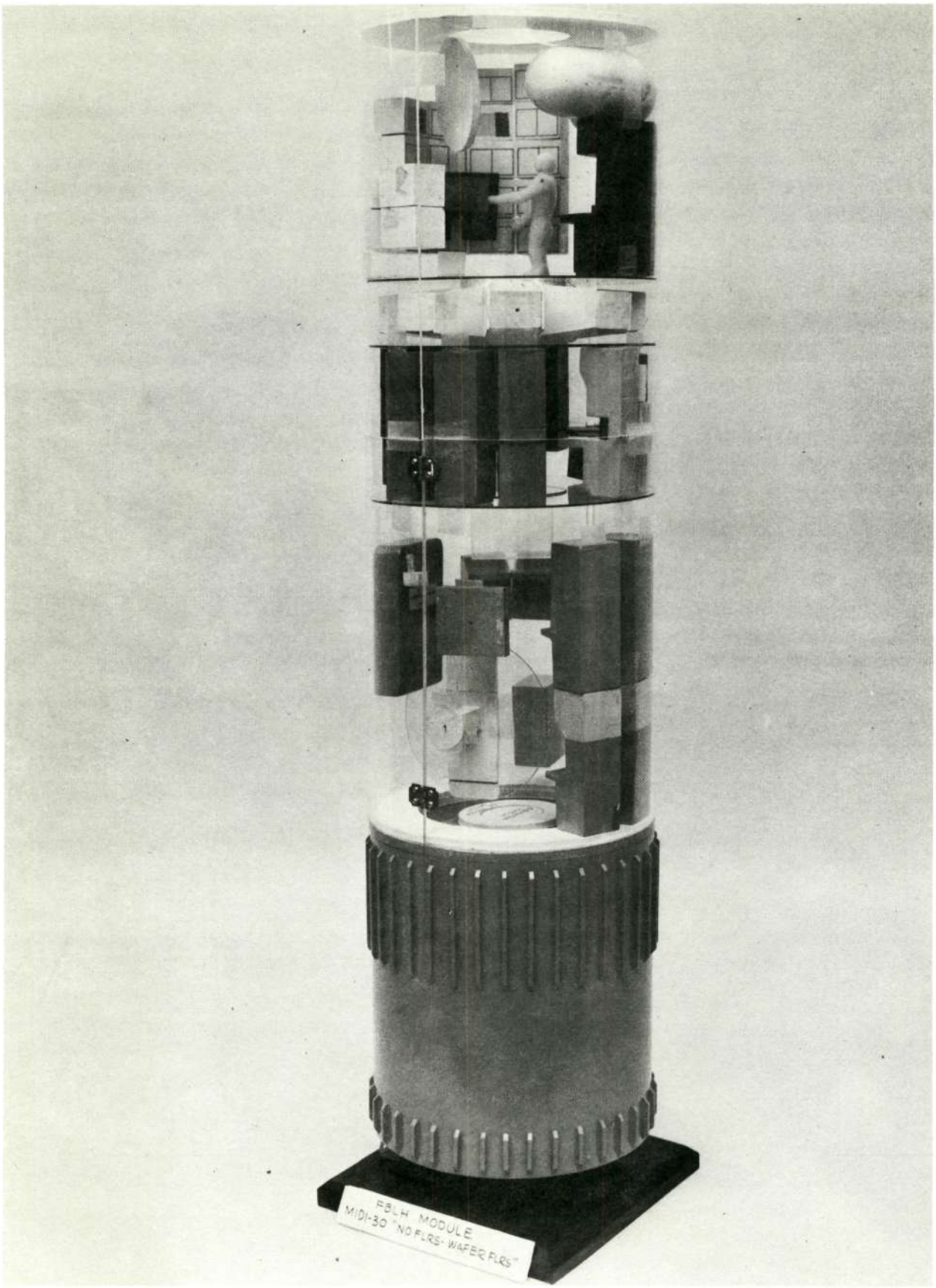


Figure I-55. FBLH Module Midi-30 "No Floors - Wafer Floors"

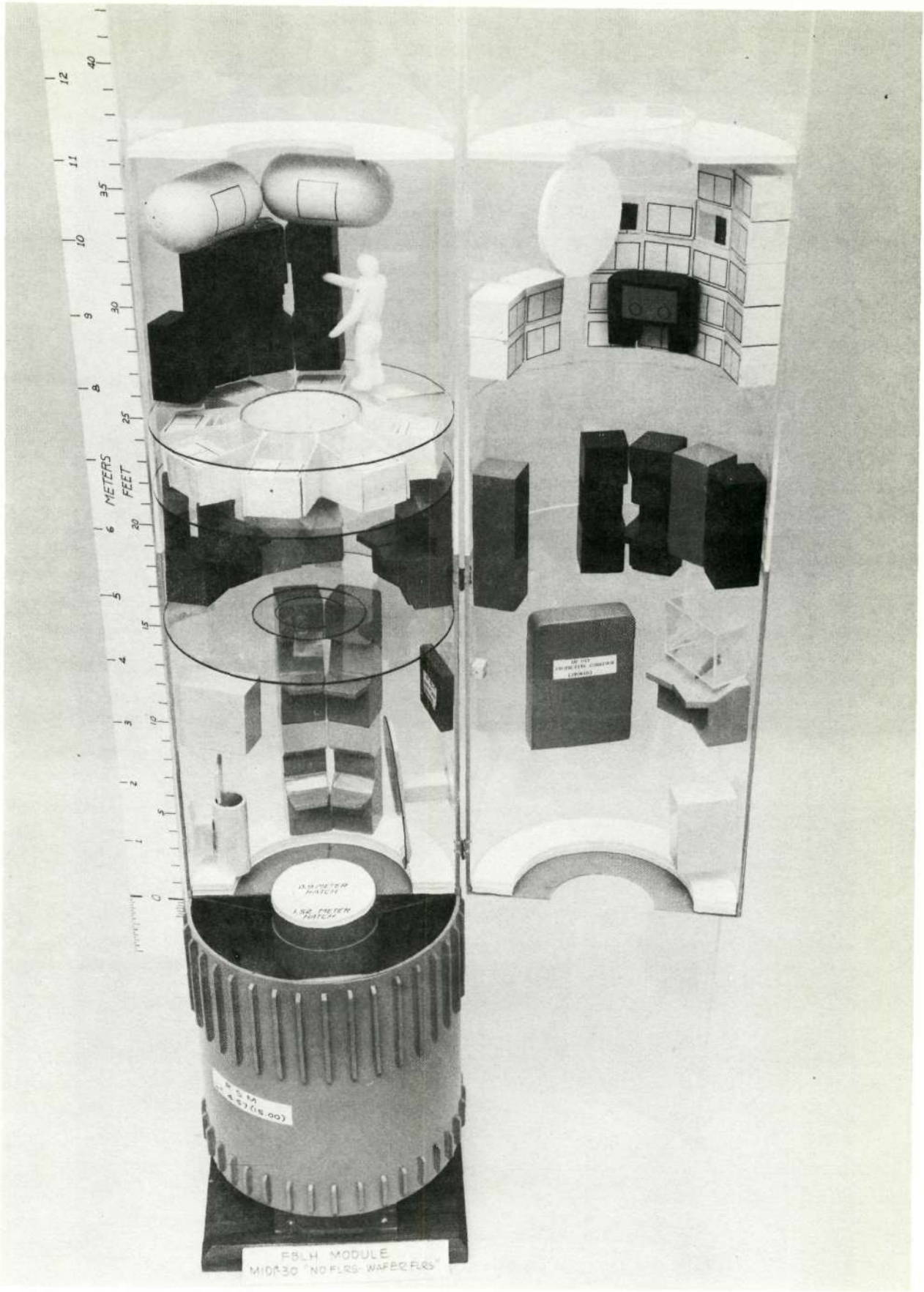


Figure I-56. FBLH Module Midi-30 "No Floors - Wafer Floors"

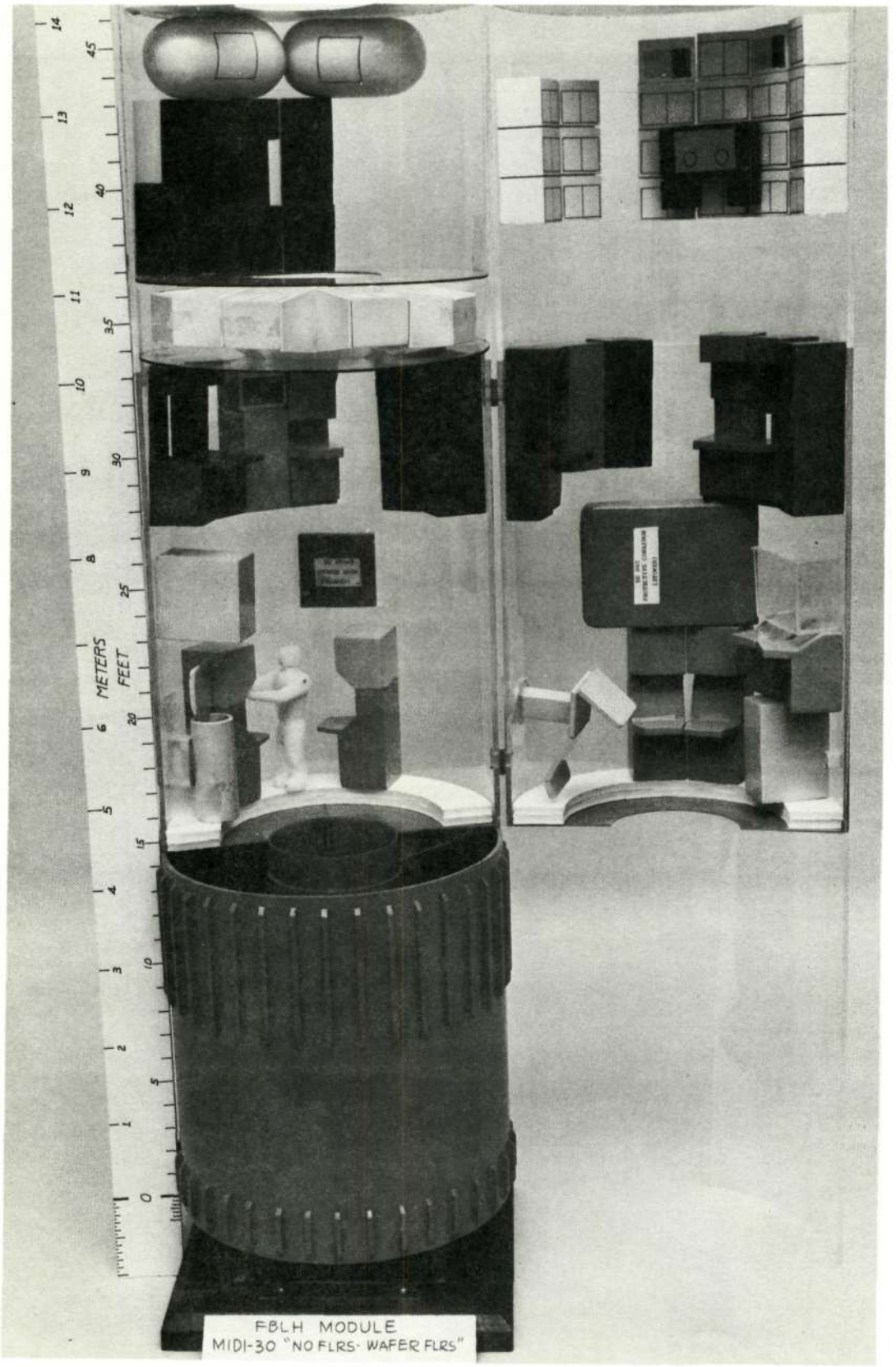


Figure I-57. FBLH Module Midi-30 "No Floors - Wafer Floors"

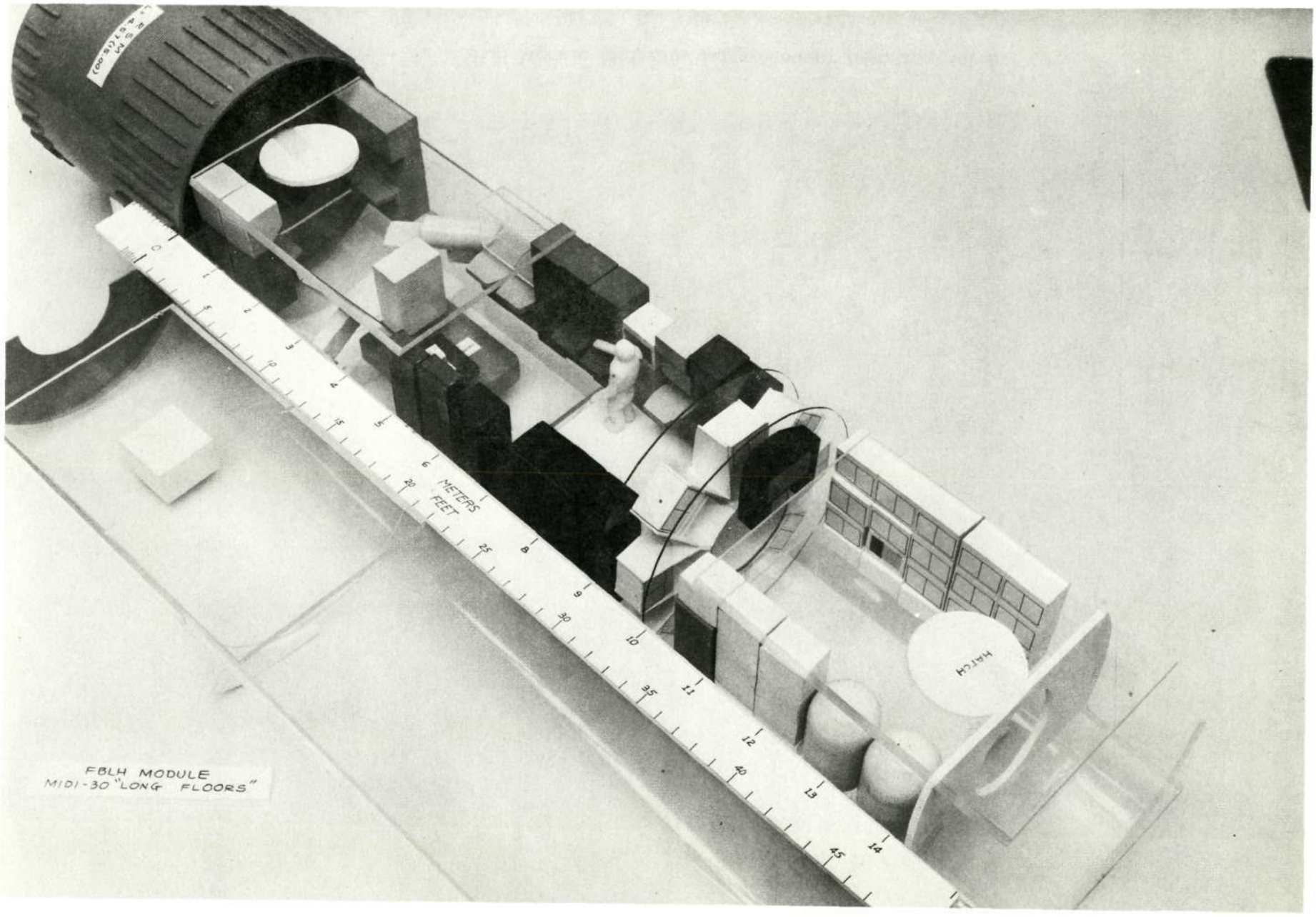


Figure I-58. FBLH Module Midi-30 "Long Floors"

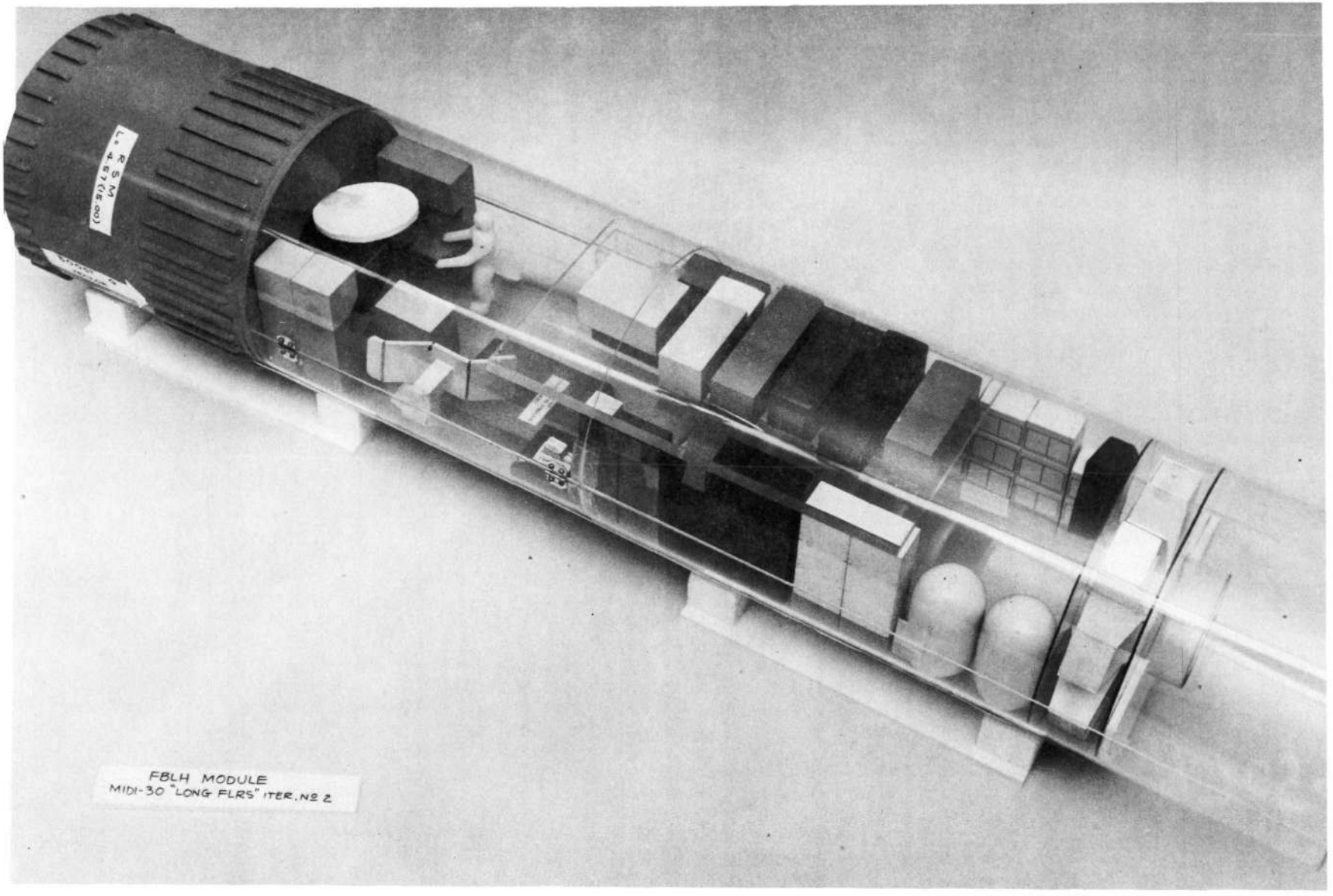


Figure I-59. FBLH Module Midi-30 "Long Floors" Iteration No. 2

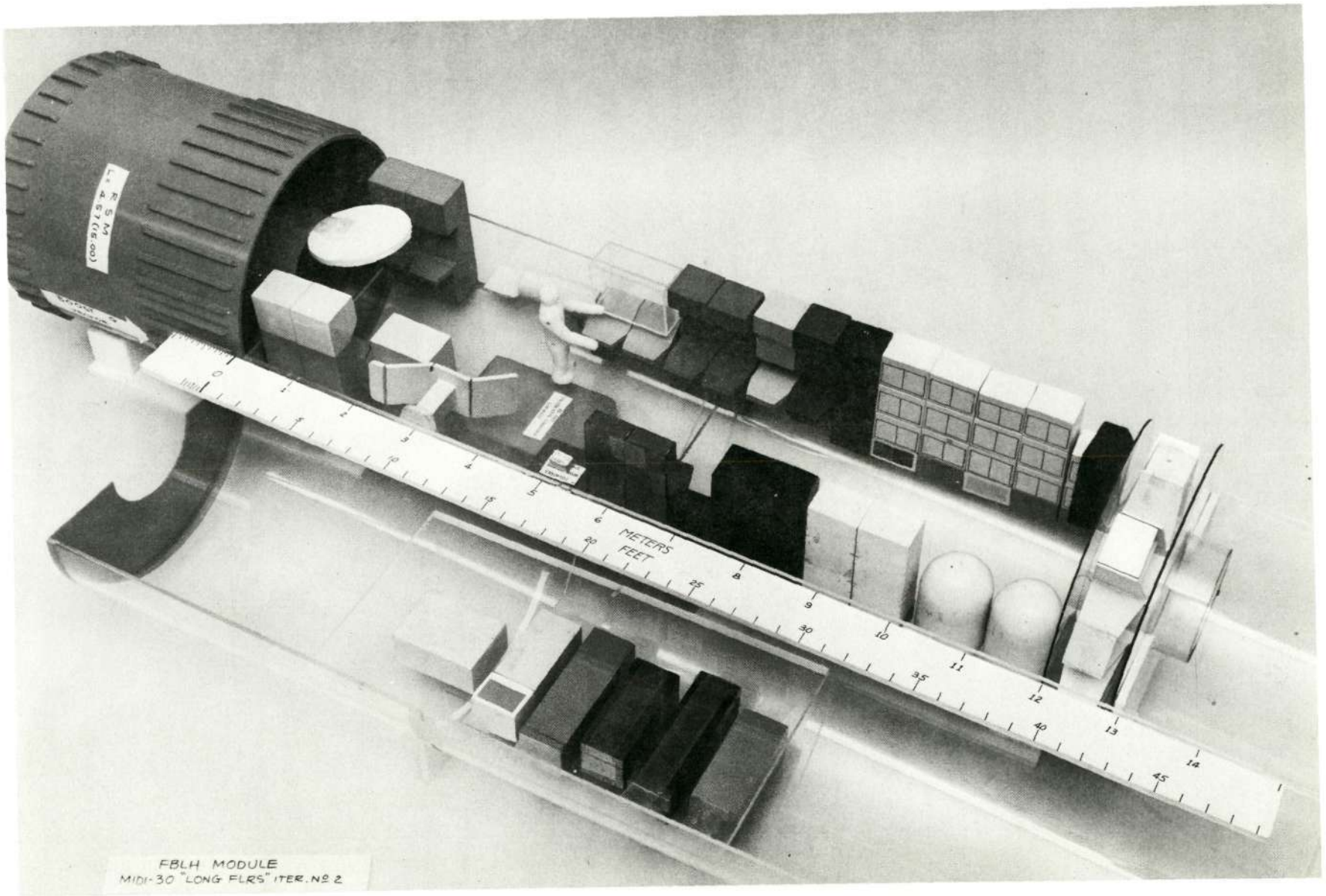


Figure I-60. FBLH Module Midi-30 "Long Floors" Iteration No. 2

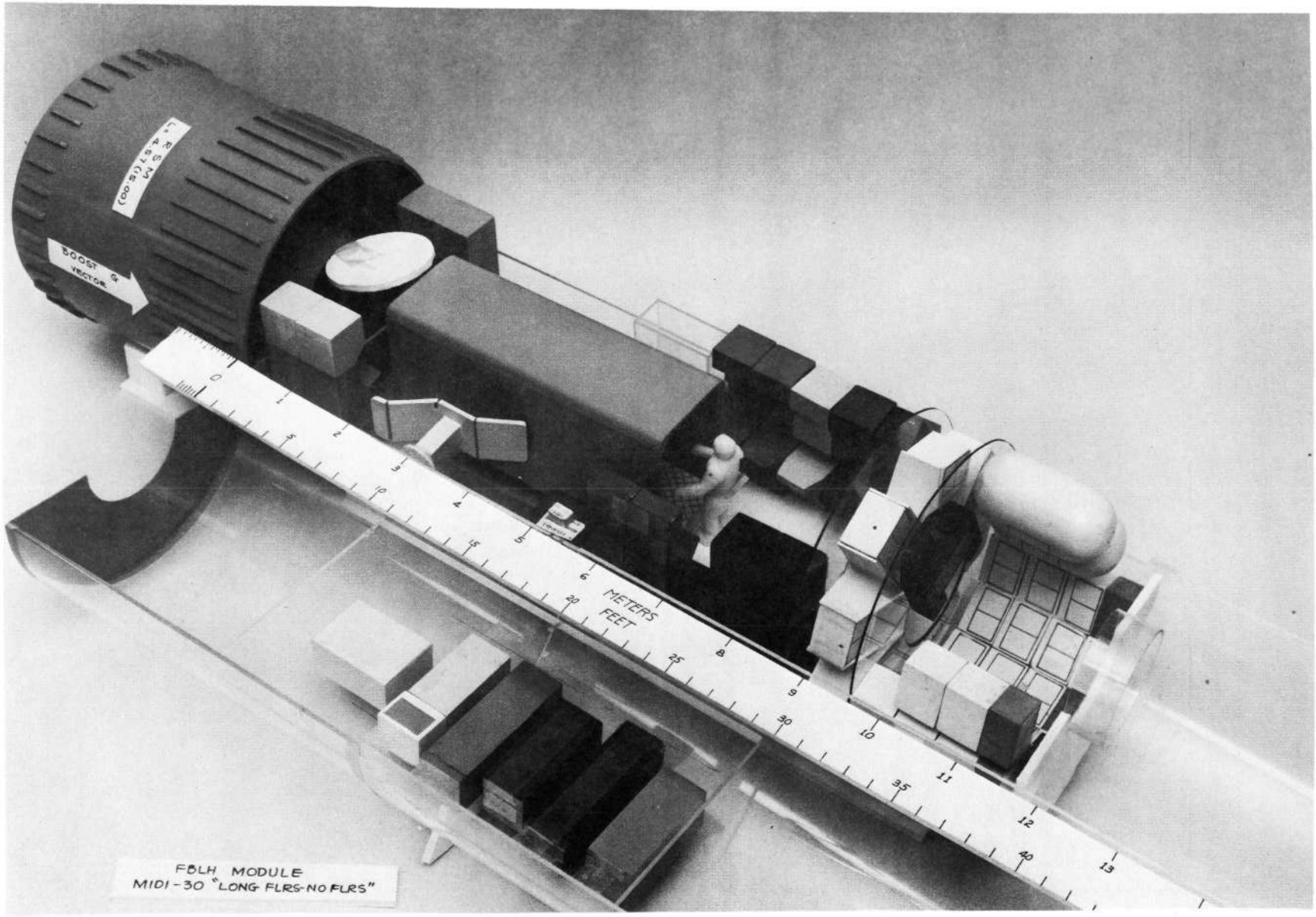


Figure I-61. FBLH Module Midi-30 "Long Floors - No Floors"

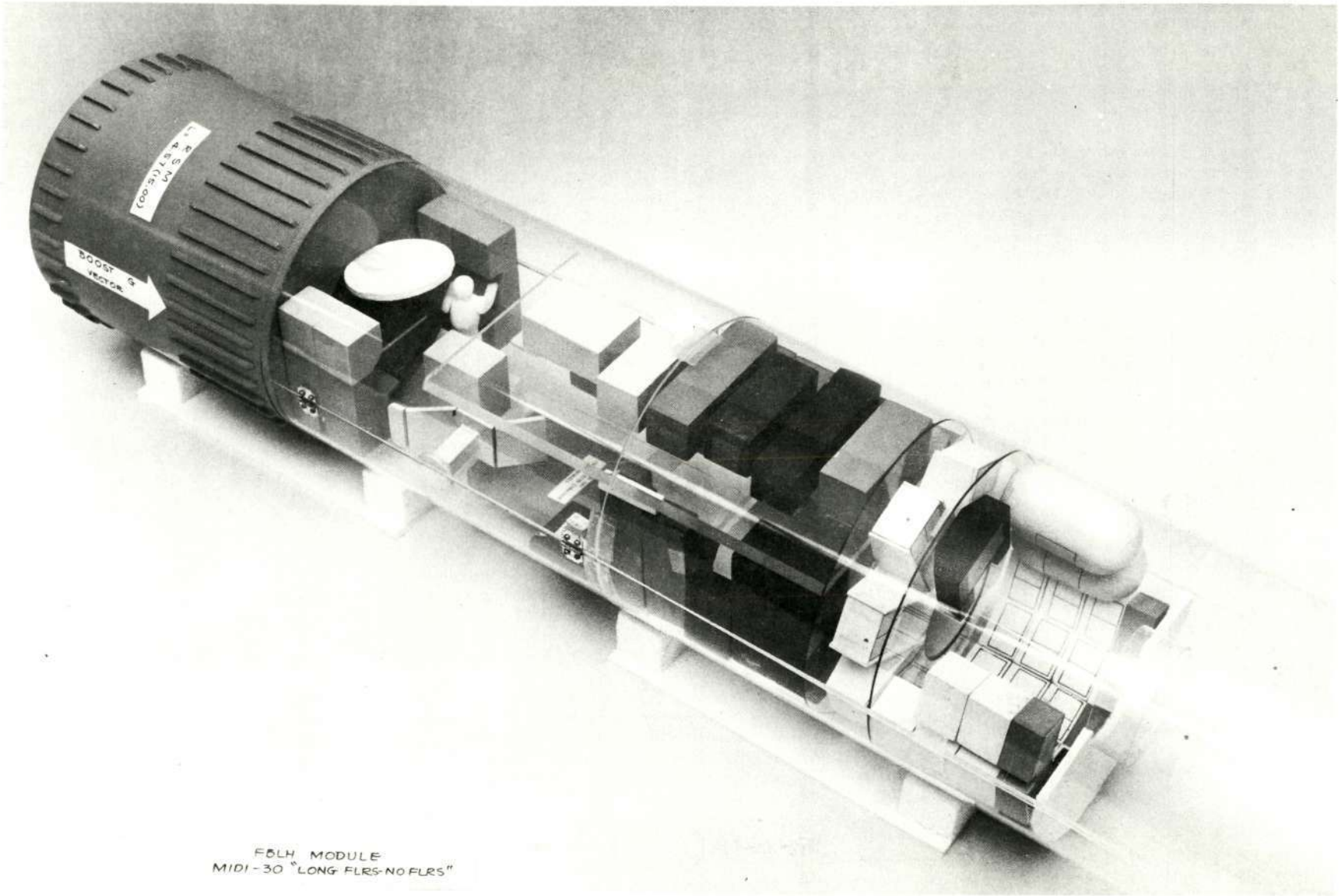


Figure I-62. FBLH Module Midi-30 "Long Floors - No Floors"

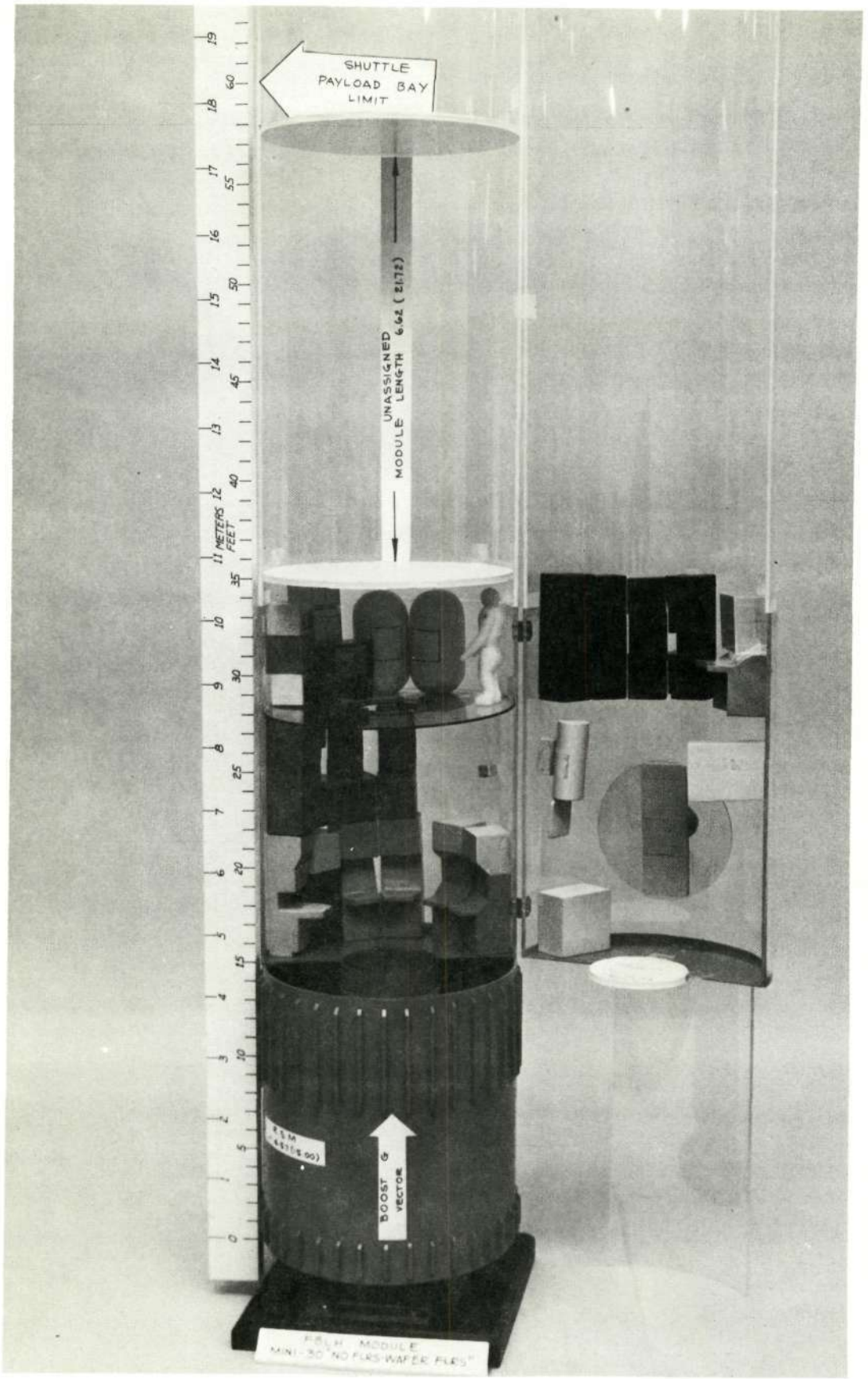


Figure I-63. FBLH Module Mini-30 "No Floors - Wafer Floors"

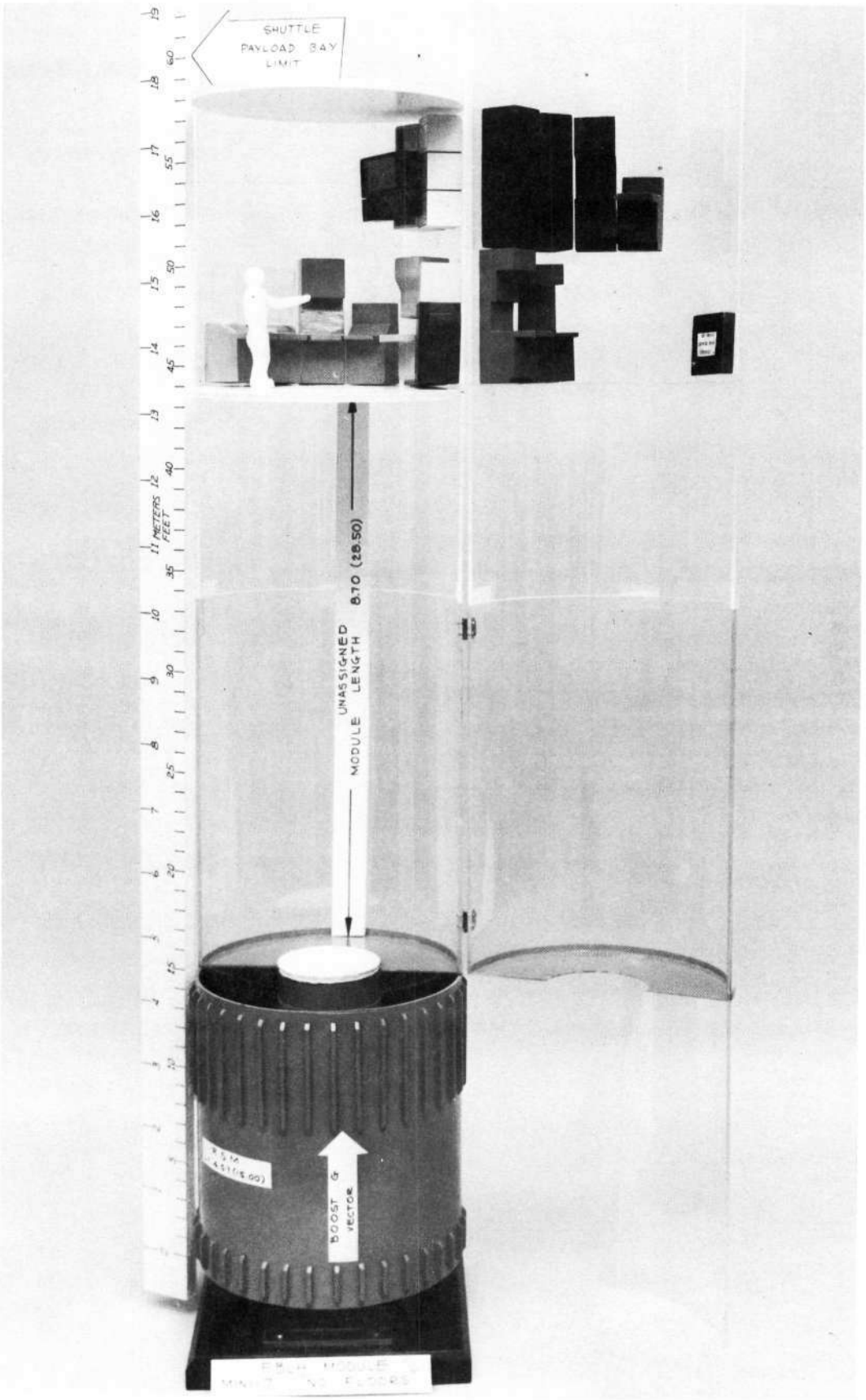


Figure I-64. FBLH Module Mini-7 "No Floors"

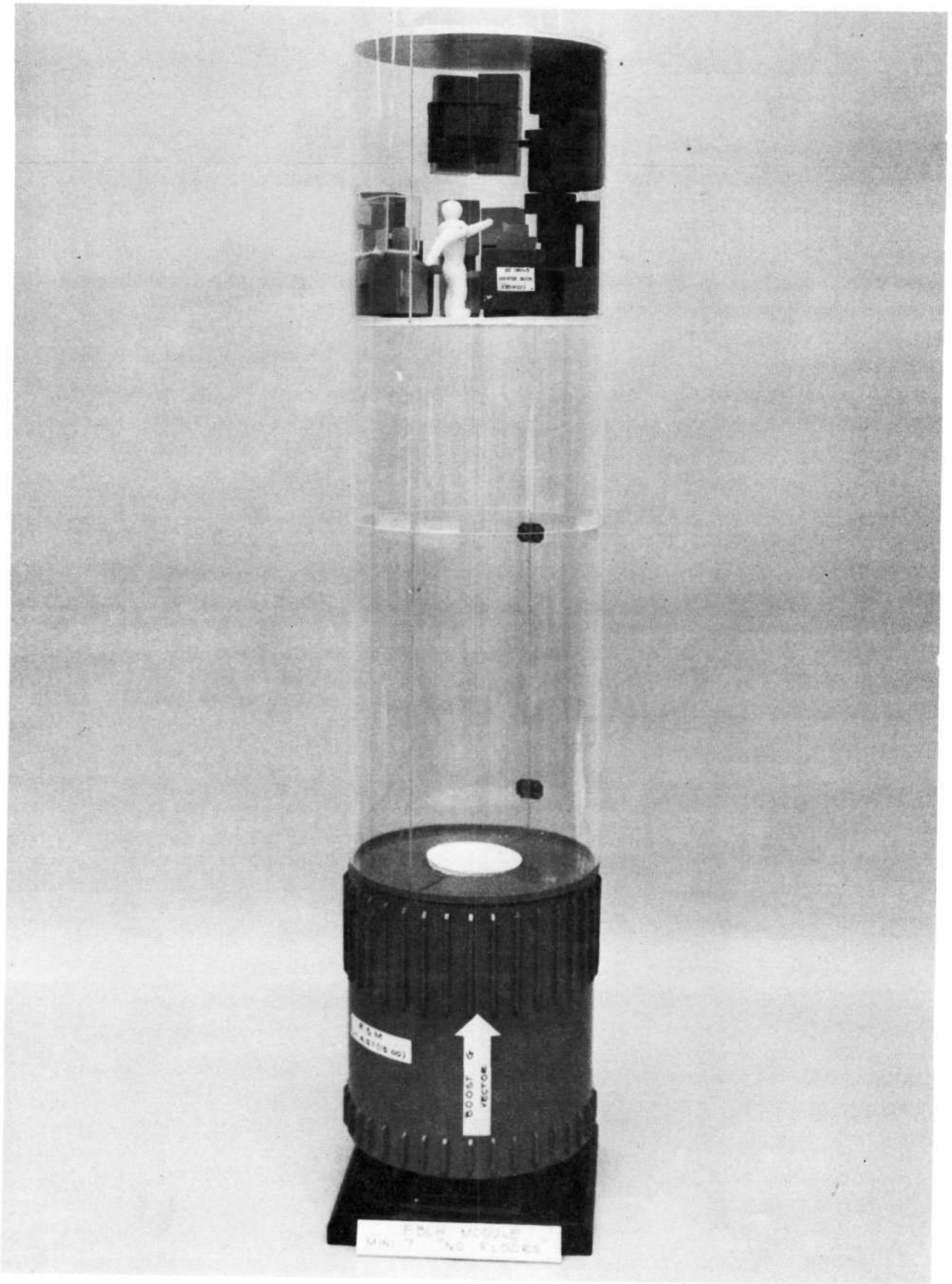


Figure I-65. FBLH Module Mini-7 "No Floors"

APPENDIX II

DATA MANAGEMENT SUBSYSTEM

This appendix presents a conceptual design for a Data Management System (DMS). The requirement of the DMS is to aid experimenters with experiment management through control of equipment and data acquisition, processing, and disposition. The ground rules used are as follows:

a. The design will build upon the concept of the Data Management Unit of the Life Sciences Common Operations Research Equipment (CORE) as presented in the "Blue Book", Reference 1. (All references of this report are presented in Section 7.1 of Volume II).

b. The concept design will be based upon data requirements presented in the Blue Book, but modified as determined necessary by the results of this current study.

c. The concept design will be limited to the basic, general-purpose framework of the DMS. Experiment instrumentation and associated special data processing devices are not considered herein. However, the DMS will be designed to readily interface with all instrumentation and such devices.

d. All external communications will be conducted via the support modules for the Sortie and Space Station missions.

e. There will be no capability for independent, detached laboratory module operations. However, there will be a capability for automatic operations during short, unattended periods such as launch.

The general approach used to design the DMS was to classify the data handling requirements, and select the concepts to be used for each requirement. Next, the hardware needed to implement each technique was determined and assembled to form an integrated data management system.

II.1 REQUIREMENTS AND SELECTION OF TECHNIQUE

Data handling requirements presented in the Blue Book were reviewed, and the kinds of data to be handled were broadly classified as: (1) sampled; (2) continuous; (3) video; (4) audio; (5) computer; (6) control; and (7) miscellaneous. In the discussion which follows, the above classifications are described, and basic handling techniques are selected. Worse case data loads were estimated

for the Maxi Max payload to insure that the selected techniques will readily provide the required capability.

II.1.1 SAMPLED DATA REQUIREMENTS. Sampled data handling requirements can by typically characterized as summarized below:

a. Acquisition - Numerous sources, slow changing, and long duration.

b. Processing - Compress (use only significant samples such as changes, trends, etc.). Compute conversion to engineering units and other typically simple computer-type operations. Update displays or activate computer-controlled devices if data meets some predetermined criteria.

c. Disposition - Store all raw data until transferred to ground. Store selected, processed data for subsequent use on-board or transfer to ground.

Measurements in this classification are typically amperage, displacement, power, force, position, pressure, strain, temperature, and voltage. This classification of data is ideally suited for handling in a pulse code modulated (PCM) form. PCM data can be readily introduced into a computer for processing, and the total PCM data stream is in an organized format that can be efficiently stored on instrumentation tape and transmitted to ground.

Most sampled data originate from analog voltage sources which are periodically sampled and converted to PCM words. However, a PCM format is, also, ideal for handling source data originating in a digital form, such as time or bi-level states (discretes), which can be grouped and handled as a single PCM word.

Some PCM data sources will be located in a centrifuge where extension of a hard wire, common data bus is not practical. This condition will require an RF link between: each bus interface unit servicing a PCM data acquistion unit located in the centrifuge, and the common data bus located in the computer area.

The bit rate of the PCM system will vary according to detailed experiment requirements and scheduling, and is not expected to exceed 62,500 bits per second (bps) for the worst case. The anticipated bit rate will allow recording of the entire raw PCM data stream on tape using a low tape speed, for later playback at a much higher speed for transfer to ground.

II.1.2 CONTINUOUS DATA REQUIREMENTS. Continuous data handling requirements can be typically characterized as follows:

a. Acquisition - Few sources, fast changing, and short duration.

b. Processing - Compress (use only significant intervals such as an anticipated event). Computer (special computer program which might require experimenter interaction through a graphic display console). Non Computer (special purpose analog data processing/display equipment).

c. Disposition - Temporarily store the most recent few minutes of all raw data. Store selected intervals of selected measurements in raw form until transferred to ground. Store selected, processed data for subsequent use on-board or transfer to ground.

Measurements in this classification are typically physiological signals, such as EGG, EEG, and EMG. Most experiments require some measurements in this classification. These signals originate in analog form from numerous sources, and a variety of special equipment is required for processing and display. Usually, only a few signals are processed at any one time. Typically, the experimenter must make some special setup of equipment to select, process, display, or store the signals desired for an experiment. For these reasons, a flexible analog data handling system is required. Basically, this system should be a network of analog data signal trunk lines, that interconnect equipment work areas and appropriate switching and signal conditioning. An RF link is required to extend trunk lines into the centrifuge.

Analog-to-digital (A/D) conversion, and computer entry of data must be provided for those signal sources and experiments that require computer support, such as waveform analysis of ECG signals. Selected analog signals must also be temporarily incorporated into the PCM format. This could be done by using a PCM data cycle format with unused time slots dedicated to this purpose. The sources of data using these time slots may often change; however, the basic PCM format will not.

A continuous data storage system will be required. Conventionally, high frequency analog signals are stored on instrumentation tape. This appears to be a desirable method since several data channels can be frequency multiplexed and stored on one track at a slow tape speed. The worse-case data storage load is estimated to be 24 channels continuously recorded.

A loop tape recorder and reproducer will be required to continuously record the most recent few minutes of selected analog channels. This will be required for experiments that produce long-time insignificant data between significant events. Occurrence of a significant event typically cannot be detected until after it has passed, at which time it is usually desirable to immediately replay the event for processing, or transfer to the main instrumentation tape for storage or transfer to ground.

There are many possible analog signal sources and destinations. The number of channels active at critical functional locations in the analog data handling system at any one time, will vary according to detailed experiment requirements and scheduling. Critical locations are expected to be computer entry, and instrumentation tape recording and playback. For computer entry, the worst case is anticipated to be equivalent to 12 channels digitized at a rate of 1000 samples per second per channel for a period of 10 seconds, with the next data interval delayed until disposition of the current data.

II.1.3 VIDEO DATA REQUIREMENTS. Television capability will be required at all principal activity areas, such as the Visual Records and Microscopy Unit, Plant Research Support Unit, and the Research Centrifuge. Other areas, such as the Plant Research Support Unit, or Holding Units may require coverage of many image sources during a single experiment. These areas could be instrumented with several cameras which time share a signal video channel, or, with a single camera that periodically scans the many sources.

Television data handling requirements can be met with a switchable network of video signal trunk lines that interconnect cameras, monitors, and video tape machines as required. There are several possible sources and users for video signals, it is estimated that not more than three channels will be active at any one time. Two video data trunk lines will require extension by RF link into a centrifuge. Television data will be stored on video tape for later review onboard, or transfer to ground via a support module. Storage and transfer requirements are not defined at this time. However, it appears that the system should provide the capability to record and/or transfer at least one channel continously.

II.1.4 AUDIO DATA REQUIREMENTS. There are no unusual audio data requirements. A handling system using conventional techniques will be suitable. The proposed handling system is basically a switchable network of audio signal trunk lines that interconnect microphones, speakers, audio tape recorders, and signal conditioners. An audio signal could be switched to an analog signal trunk, and treated as an analog signal to record on tape. It is estimated that not more than three audio channels will be required to be active at any one time.

Audio communication between portable equipment where hard wire links would be impractical, or between main laboratory and a centrifuge, will require RF links.

At least two multichannel voice tape recorders will be required. One permanently located recorder to continuously record all active audio channels and an analog time code. One audio channel will be permanently assigned to the support module. The other tape machine would be portable, and used to both record and reproduce modes as required by various experiments. Any of the audio

signal trunk lines would be selectable to either tape machine, recording, or playback of audio data.

II.1.5 COMPUTER DATA REQUIREMENTS. The data management computer will be required to handle many kinds of data from several sources, and perform a variety of computer operations. Computer data sources and users are summarized as follows:

a. Sources:

1. PCM data
2. Digitized analog data
3. Time from time code generator
4. Storage data from quick access computer storage
5. Storage data from computer tapes
6. Transferred computer data from service module
7. Interactive graphics data, both control and display

b. Users:

1. Control data to external devices
2. Storage data to quick access computer storage
3. Storage data to computer tape machines
4. Transferred computer data to service module
5. Digital-to-analog converted data
6. Interactive graphics data, both control and display

Each of these data links with the computer will require a hardware interface to condition the data and manage the transfer from one medium to another. In some cases the interfaces require conventional capabilities, such as those for the quick-access storage of computer tapes. However, in most cases the interfaces will require unusual functional capabilities. An important consideration is to relieve the computer of high-rate repetitive functions that are most efficiently accomplished externally.

Input/output requirements for some classifications of data that the computer must handle (sampled, continuous and control) have been discussed in the requirement sections dealing with these classifications. Very little information covering requirements for computer data storage size, and processing rate is

available. However, an estimate of worse-case, quick-access storage requirements are summarized below. The unit of storage is assumed to be a 16-bit word. ((TOTAL) 1,667,296 words (approximately 30×10^6 bits)).

a. PCM data request file - 128 words per frame, 32 frames per data cycle: 4096 words.

b. Device control request file - 240 words per frame, 30 frames per control cycle: 7200 words.

c. Instruction file - 5000 measurements, 300 characters (150 words) per measurement: 750,000 words.

d. Computer data file inventory file - 200 files, 60 characters (30 words) per file: 6000 words.

e. Computer data file storage - 100 files, 5000 words per file: 500,000 words.

f. Graphic frame file storage - 50 files, 500 words per file: 25,000 words.

g. Graphic display format files - 20 files, 250 words per file: 5,000 words.

h. Current experiment procedure file - 10 experiments, 5,000 words per experiment: 50,000 words.

i. System and utility program library - 20 programs, 4000 words per program: 80,000 words.

j. Application program library - 40 programs, 4000 words per program: 160,000 words.

k. Working buffer area - 40 buffers, 2000 words per buffer: 80,000 words.

The above assumes that long intervals of a raw data stream entering the computer are to be stored on computer tape. In addition, large files of data seldom used, will be stored on computer tape.

Experiments using the Biomedical Measurement Unit of the Medical Research Facility, that originate ECG type signals will impose the worse-case processing load on the computer. These will require wave-form analysis. This processing must be accomplished without disrupting the ever-present handling of PCM data, and control of devices. These experiments may require management by an experimenter interacting through a computer graphics display/control console. This would impose an additional load on the computer. It was previously stated that 12 ECG-type signals, digitized at a rate of 1000 samples per second for 10 seconds, is estimated to be the worse-case load. This acquired data must be analyzed, the results stored, and the experiment setup modified before the next interval of data are acquired.

Transfer of computer data between the data management computer and the service module, or storage devices does not impose a significant load on the data management computer, because transfer links are managed by automatic devices peripheral to the computer.

The computer requirements to service interactive graphics data are difficult to estimate. Graphics will impose severe short-term loads if this technique is often used as the primary experiment management and analysis tool. If more detailed experiment plans and requirements reveal this to be the case; then, all computer graphics functions possible should be incorporated in specific purpose graphics equipment peripheral to the computer. This would reduce the load on the computer.

II.1.6 DEVICE CONTROL DATA REQUIREMENTS. Equipment operations in the laboratory must be automated by computer control, where practical, in order to minimize experimenter attention, and to insure reliable operation. Most of these operations are simple, low rate, and long term. Typically, a sensor is sampled by the PCM system and a status display is updated, and if the condition is out of some predetermined tolerance, an equipment operation is automatically initiated by the computer which restores the sensed condition to an acceptable state. An example of this kind of operation is the monitoring and control of an environmental control parameter.

Certain equipment must be operated in some prescribed sequence in order to support an experiment. An example of this is the control of a light, by computer programmed light/dark cyclic series. Some equipment operations are under control of an experimenter via the computer. This kind of operation usually supports an experiment where human judgment must direct the computer to one of several possible, programmed courses of action.

Another mode of control is required for the situation where an externally sensed condition might occur at an unpredictable time, and then needs the immediate attention of some process program in the computer. Conventional computer interrupt signals could be used for this situation. The interrupt capability could be inhibited during periods when action is not necessary. Many interrupts will be required at various work stations. For example, a computer graphics console, for human control of experiments.

There will be many kinds of devices using control data from the computer. Some of these devices are special-purpose instrumentation, and must incorporate specially designed interfaces to the general-purpose framework of the data management system. Device control data can be broadly separated into two classes; scheduled, and unscheduled. The worse-case control word output rate required of the computer is estimated to be less than 240 words per second for scheduled control. The unscheduled rate is less. The total rate imposes an insignificant load on the computer.

II.1.7 MISCELLANEOUS DATA REQUIREMENTS. This classification includes general-purpose film using equipment, and signal conditioners not included elsewhere.

II.2 DATA MANAGEMENT SYSTEM FUNCTIONAL DESCRIPTION

The Data Management System functional capabilities are illustrated in Figure II-1. Its functional capabilities are most conveniently described by considering each of its major functions separately. These are presented in the following sections, along with block diagrams illustrating the equipment and functional inter-relationships. The software functional blocks shown are not intended to illustrate all software functions, rather, only those necessary to describe how the computer functions with its associated peripheral equipment. The quantity of equipment units required will vary according to overall data management requirements. However, the functional design of the system is intended to be independent of load, within anticipated bounds.

A summary of data management equipment is shown in Table II-1. The weight, power, and volume requirements for the smaller payloads shown in the table appear unreasonably high. This is due to the assumption that all basic DMS capabilities would be included for the smaller Life Sciences payloads, and the DMS would be shared by other FPE payloads.

II.2.1 PCM DATA HANDLING. Functional capabilities for handling PCM data are illustrated by the PCM Data Control Unit shown in Figure II-2 and the PCM Data Acquisition Unit shown in Figure II-3. PCM data acquisition is controlled by the data management computer, by execution of the data acquisition program. Modification and initial execution of this program is by operator control. During initial execution, direct-memory-access (DMA) channels of the computer and a peripheral PCM data formatter are "setup". Thereafter, all PCM data acquisition operations proceed automatically under control of the DMA channels and PCM data formatter.

During normal operation, the formatter issues a word transfer request (at a rate specified during setup) to the data request output DMA channel. The DMA channel accesses the data request buffer (in computer core storage) for the next data request and outputs it to the formatter and the common data bus, via a bus interface unit. The data request is actually a function code, and the address of a PCM data acquisition unit and one of its multiplexer channels. In other words, the address of the data source. The multiplexer channel is sampled, and the resultant data word is sent to the formatter via the common data bus. The formatter holds the address and data word for a length of time sufficient to maintain the constant word rate specified during the setup. The formatter then issues a word transfer request to the computer data input DMA channel. The DMA channel inputs the data word and stores it in the PCM data input table (in

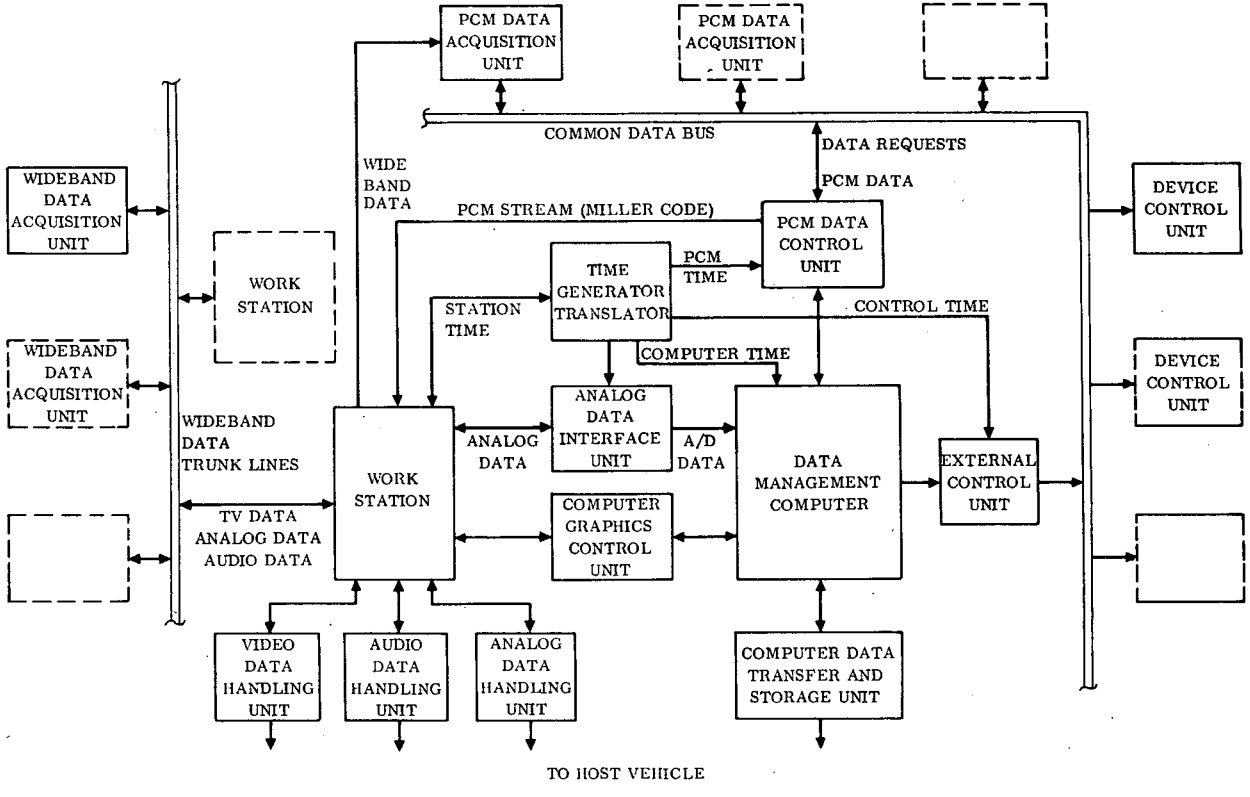


Figure II-1. Data Management System Function Block Diagram

Table II-1. Data Management System Equipment Summary

Equipment Group	PAYLOADS											
	MINI-7			MINI-30			MAXI-NOM			MAXI-MAX		
	Weight kg (lbs)	Vol. m^3 (ft^3)	Power w	Weight kg (lbs)	Vol. m^3 (ft^3)	Power w	Weight kg (lbs)	Vol. m^3 (ft^3)	Power w	Weight kg (lbs)	Vol. m^3 (ft^3)	Power w
PCM Data	16	.023	55	20	.029	75	24	.035	95	46	.065	195
Analog Data	132	.273	1020	132	.273	1020	144	.282	1040	198	.345	1290
Video Data	81	.179	605	81	.179	605	98	.210	665	122	.257	780
Audio Data	12	.018	180	12	.018	180	13	.020	200	26	.039	390
Computer Data	195	.476	1385	195	.476	1385	211	.494	1435	307	.829	2201
Computer Device Control	10	.014	50	12	.017	60	16	.023	80	28	.041	140
Misc. Data	7	.015	5	7	.015	5	7	.015	5	12	.020	10
TOTAL	453 (998)	.998 (35.2)	3300	459 (1012)	1.007 (35.6)	3330	513 (1132)	1.079 (38.1)	3520	739 (1630)	1.596 (56.3)	5006
MINI-7 1/3 Share	150.9 (333)	.333 (11.7)	1100									
MINI-30 2/3 Share				306.0 (674)	.672 (23.7)	2220						

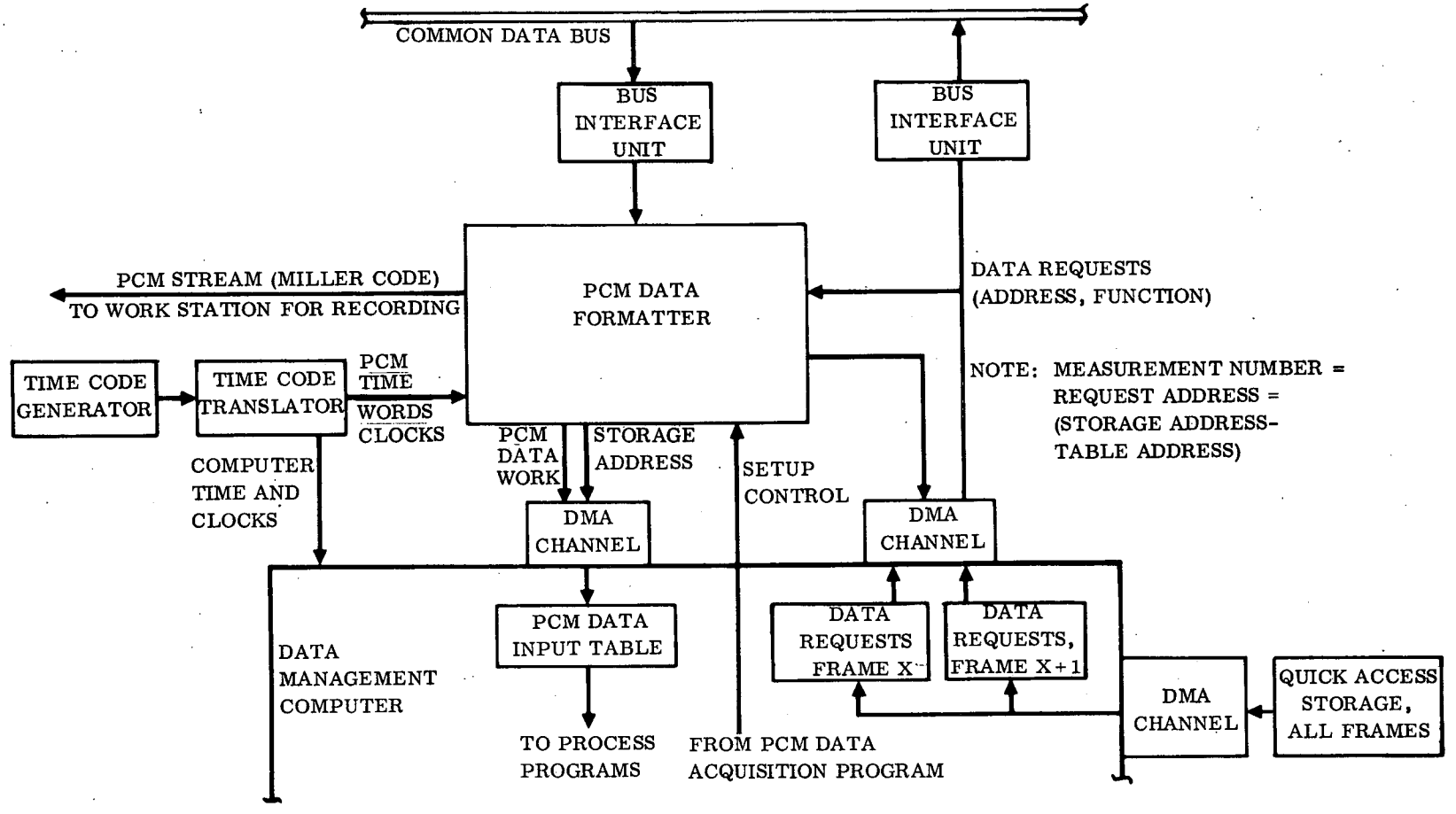


Figure II-2. PCM Data Control Unit - DMS

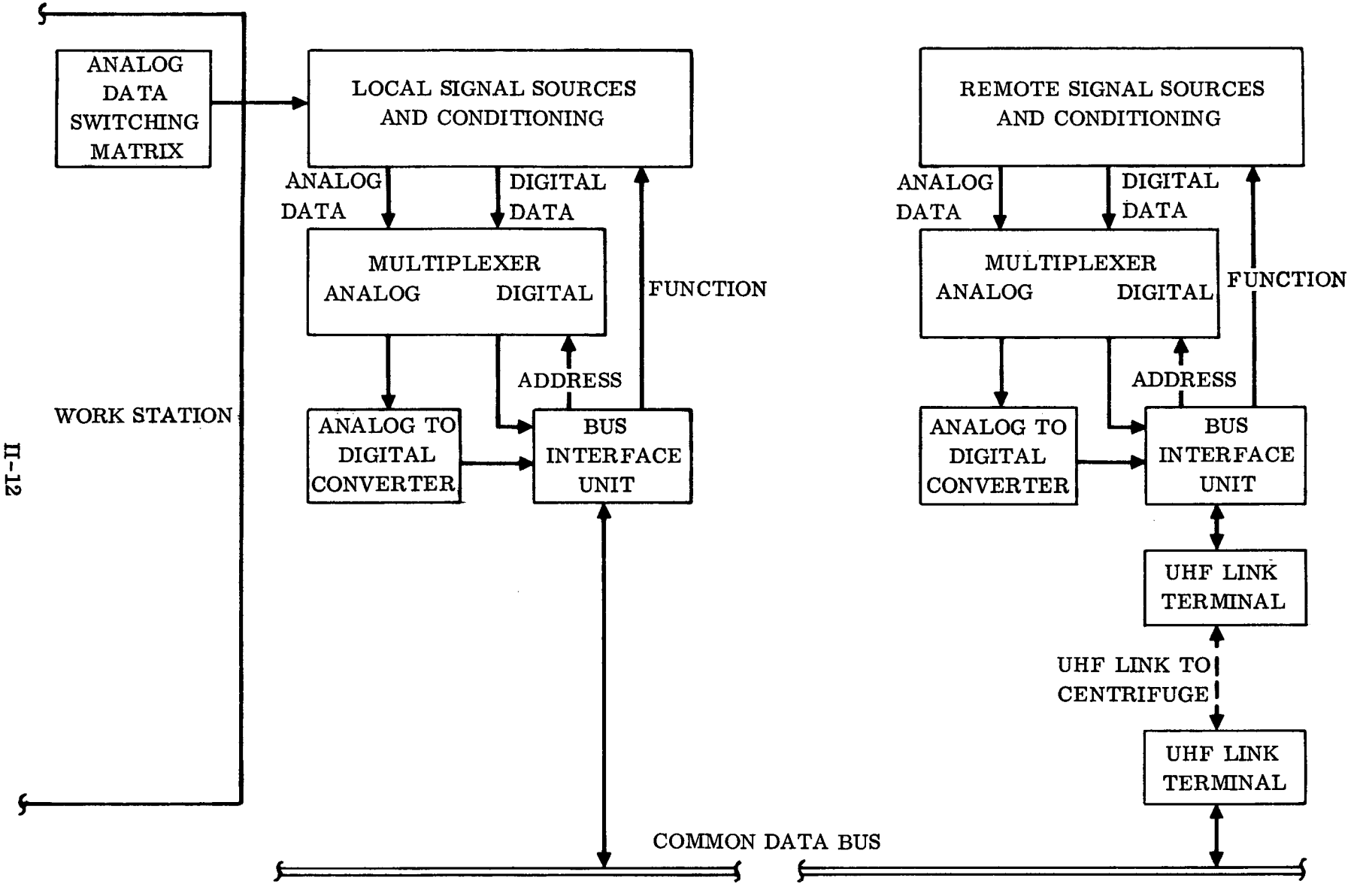


Figure II-3. PCM Data Acquisition Unit - DMS

computer core storage) at a location derived from the address. Note that the address serves as a unique number to identify each measurement, its source, and its location in the PCM data input table.

Two data request buffers are used. The buffers are alternately emptied by the data request DMA channel, and alternately filled by the request file DMA channel which transfers requests from the quick-access storage. The size of a data request buffer is defined as a data frame. The size of the data request file is a multiple of the data request buffer size, and is defined as a data cycle.

There are no hardware limitations as to how often one multiplexer channel is sampled relative to another, or in the order that they are sampled. These are software functions, and are determined solely by how often and in what sequence the data requests appear in the data request file. Intermittent, high sampling rate acquisition of a few sources is accommodated without modifying the basic data cycle. This is done by initially formatting the data request file with unused time slots dedicated to this purpose.

When the last data request of a frame in the data request buffer has been transferred out, the DMA channel issues an end-of-range interrupt to the computer. The computer then directs the DMA channel to the other buffer and initiates updating of the recently completed buffer. Data requests at the start of each frame are assigned addresses by the formatter. The formatter uses these time slots to merge frame sync code, frame number, format number, and time with the data word stream.

The PCM formatter also generates, and outputs a PCM bit stream in Miller code for recording on instrumentation tape and subsequent transfer to ground. As an example; current techniques allow a PCM Miller code at a rate of 62,500 bps to be recorded at a tape speed of 4.8 CM per second (1-7/8 inches per second). One track of a tape, 1463 meters (4800 ft) in length, would store over 8 hours of data. The tape is played back at a speed of 304.8 CM per second (120 ips), requiring less than 8 minutes, and would produce a transfer rate of 4×10^6 bps. One track of the tape could store almost 2×10^9 bits. A 14-track tape could store over 112 hours of data (over 2×10^{10} bits). Storage density would be over 12,990 bits per CM (33,000 bits per inch) per track.

The PCM data input table is the interface with all data user computer programs. The table is being constantly updated independently of process programs that use the data. Several processing programs can time-share the computer, each selecting only those measurements required, and at whatever rate they choose. A PCM data handling equipment list is shown in Table II-2.

Table II-2. PCM Data Equipment List - DMS

Equipment Item	Weight kg (lbs)	Volume m^3 (ft^3)	Power Watts	Quantity Per Payload			
				MINI -7	MINI-30	Maxi-Nom	Maxi-Max
PCM Data Formatter	6.8	.011	15	1	1	1	1
PCM Data Acquisition Unit	2.2	.003	10	4	6	8	18
	Total Weight			15.6 (34)	20.0 (44)	24.4 (54)	46.4 (102)
	Total Volume			.023 (.64)	.029 (.82)	.035 (.99)	.065 (1.84)
	Total Power			55	75	95	195

II.2.2 ANALOG DATA HANDLING. Capabilities for handling analog data are illustrated by the Analog Data Handling Unit in Figure II-4, the Analog Data Interface Unit in Figure II-5, and the Wide-band Data Acquisition Unit in Figure II-6. The analog data handling system is a group of analog data acquisition, processing, signal conditioning, switching, and storage equipment interconnected by a network of wide-band data trunk lines.

Wide-band data acquisition units are used at remote locations where analog data sources, and users are concentrated. A selector unit at each acquisition unit is used by the experimenters to connect selected signal sources and users, in the vicinity, to the trunk lines. The trunk lines terminate at a switching matrix in an analog data handling unit. This analog data switching matrix is used by the experimenters to route signals between acquisition units, or between trunk lines and nearby, commonly used analog data handling equipment.

Most elements of the analog data handling system can be operated simultaneously, and independently of the others. Analog data may be handled independently of the data management computer, and the other data handling systems (PCM, video, audio, computer, and device control). However, three analog data links to the computer are provided for those operations that require computer support. One link is provided by signal lines from the analog data switching matrix to multiplexer channels of a PCM data acquisition unit. The PCM acquisition unit used, would be one located near the switching matrix, and some of its multiplexer channels would be reserved for this purpose. The resultant acquired data would be incorporated into the PCM data stream. Another link is provided by signal lines from the switching matrix to an analog-to-digital converter that inputs data into the computer. The third link is provided by digital-to-analog converters for data from the computer to the analog data switching matrix.

Selector units of the wide-band data acquisition units are remotely controlled by a switching keyboard adjacent to the analog data switching matrix. This allows one experimenter, at a central location, to interconnect analog equipment to any configuration. All switching functions could readily be designed to operate under computer control, if more detailed requirements show this to be desirable. All commonly used analog data handling equipment (tape machines, oscilloscopes, strip-chart recorder, etc.) would be located near the analog data switching matrix for convenience of interconnection, and to minimize signal line lengths. A list of analog data handling equipment is shown in Table II-3. Trunk lines in the main laboratory, and the centrifuge are interfaced with RF links.

High frequency analog data are stored on instrumentation tape. The analog signals are converted to frequency modulated, constant bandwidth data. Several subcarriers are multiplexed together and recorded on a single track. During

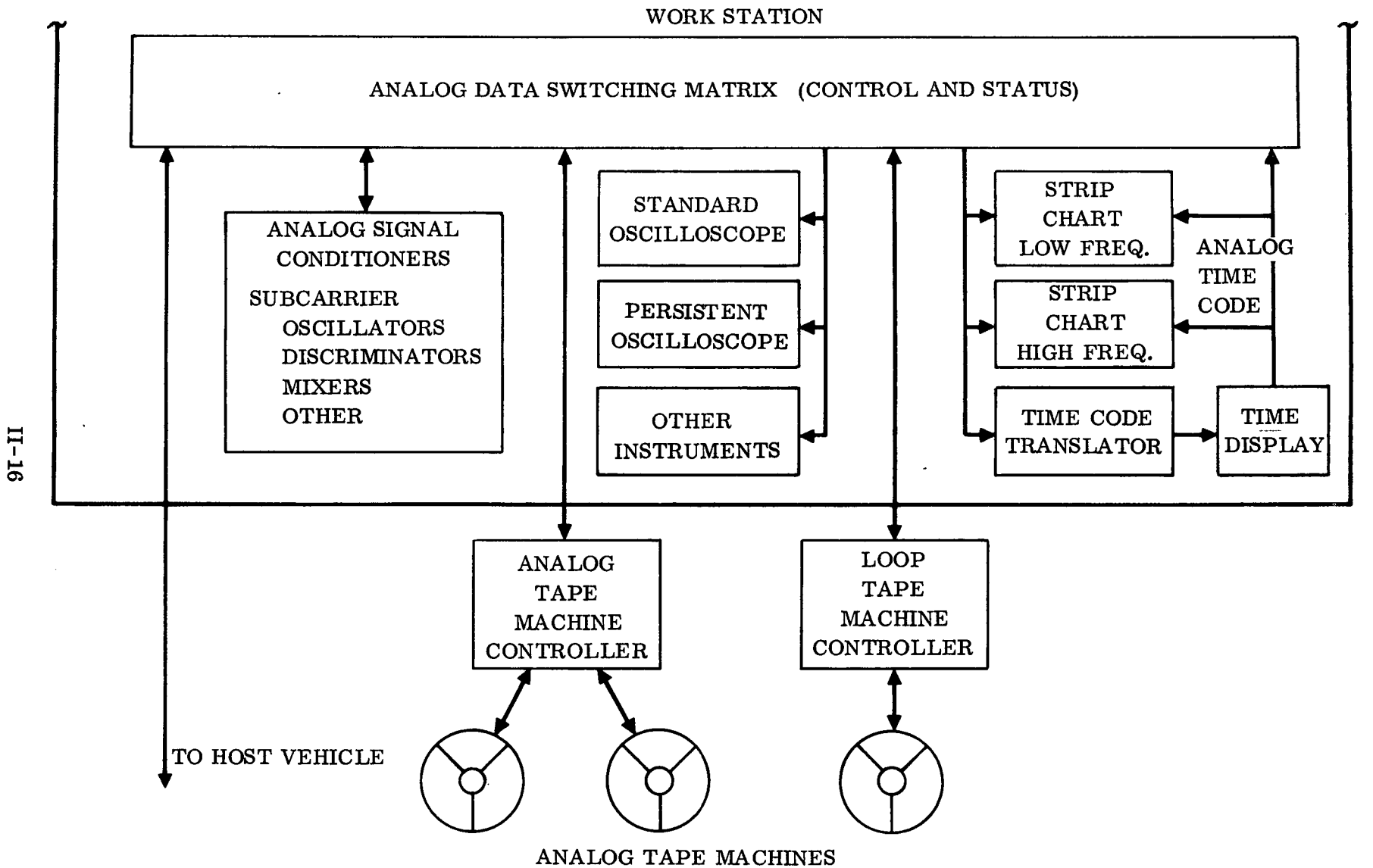


Figure II-4. Analog Data Handling Unit - DMS

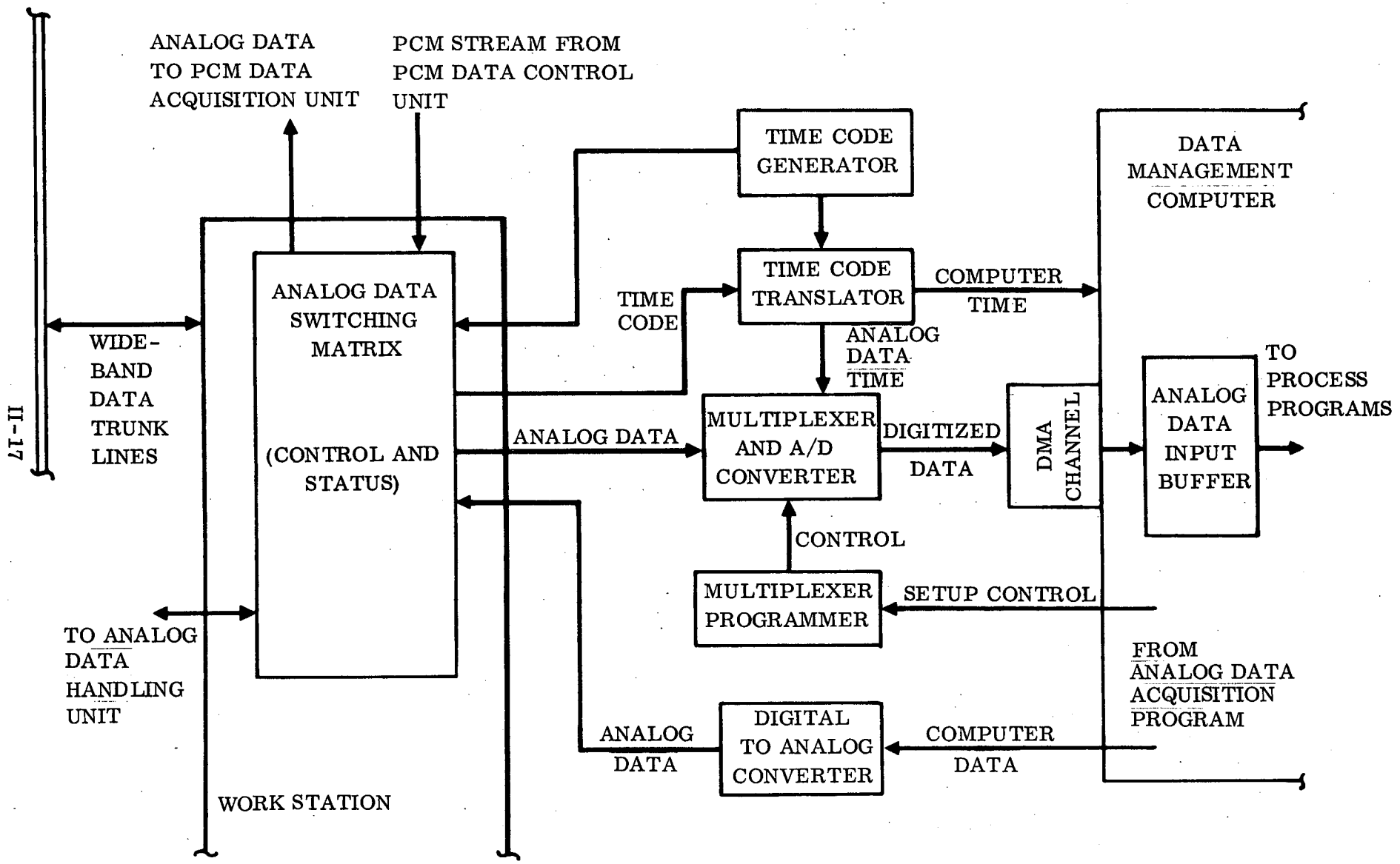


Figure II-5. Analog Data Interface Unit - DMS

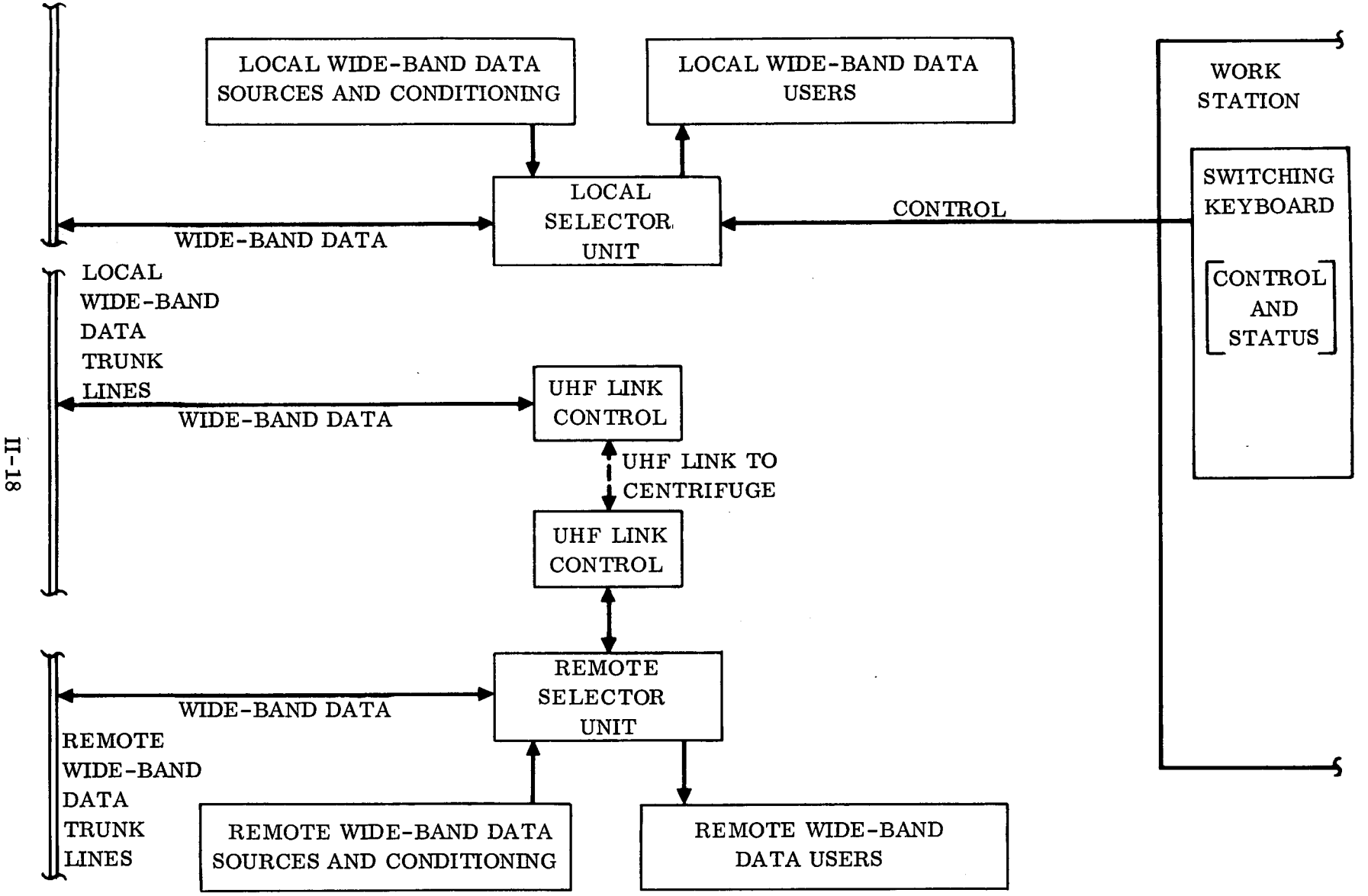


Figure II-6. Wide-Band Data Acquisition Unit - DMS

Table II-3. Analog Data Equipment List - DMS

EQUIPMENT ITEM	Weight kg (lbs.)	Volume m^3 (ft^3)	Power Watts	Quantity Per Payload			
				MINI-7	MINI-30	MAXI-NOM	MAXI-MAX
Multiplexer and A/D converter (24)	3.6	.005	10	1	1	1	1
Digital to Analog Converter (12)	1.4	.001	10	1	1	2	2
Analog Data Switching Matrix	4.0	.005	30	1	1	1	3
Analog Data Trunk Lines (12)	5.0	.005	-	1	1	2	3
Analog Tape Signal Conditioner (12)	4.0	.002	30	2	2	2	4
Analog Tape Machine (2)	36.4	.113	400	1	1	1	1
Loop Tape Machine	10.0	.030	100	1	1	1	1
Oscilloscope-Standard	12.0	.030	50	1	1	1	2
Oscilloscope-Persistent	12.0	.030	50	1	1	1	1
Strip-Chart Recorder-Low Freq.	10.0	.020	100	1	1	1	1
Strip-Chart Recorder-High Freq.	15.0	.020	200	1	1	1	1
Analog Time Code Translator	2.0	.002	5	1	1	1	1
Time Display	1.0	.002	5	1	1	1	3
Wide-band Data Acquisition Unit	5.0	.002	10	2	2	3	6
Switching Keyboard	2.0	.002	20	1	1	1	3
Total Weight				132.4 (290)	132.4 (290)	143.8 (316)	197.8 (435)
Total Volume				.273 (9.6)	.273 (9.6)	.282 (10.0)	.345 (12.2)
Total Power				1020	1020	1040	1290

playback, the subcarriers are separated and frequency discriminated to reproduce the original analog signal. As an example, current techniques allow 12 analog signals, each with a frequency response of 500 Hz to be recorded on one track of tape. At a tape speed of 19.05 CM per second (7-1/2 inches per second), one track of a tape 1463 meters (4800 ft) in length could store more than 2 hours of data. A tape with 14 tracks could store more than a full day of continuous recording. A track of data could be played back at 304.8 CM per second (120 ips) and transmitted, using a 2 MHz bandwidth. This would require eight minutes of transmission.

II.2.3 VIDEO DATA HANDLING. Functional capability for handling video data are illustrated by the Video Data Unit shown in Figure II-7, and the Wide-Band Data Acquisition Unit shown in Figure II-6. The video data handling system is a group of video equipment; such as cameras, camera commutators, monitors, switching, and tape machines interconnected by a network of wide-band data trunk lines.

The equipment and functions for the analog, video and audio data handling systems are similar, and should be packaged together to save weight and space wherever possible. A video data handling equipment list is shown in Table II-4.

II.2.4 AUDIO DATA HANDLING. Functional capabilities for handling audio data are illustrated by the Audio Data Handling Unit shown in Figure II-8, and the wide-band Data Acquisition Unit shown in Figure II-6. The audio data handling system is a group of audio equipment; such as communication on sets, and switching and tape machines interconnected by a network of wide-band data trunk lines.

Audio communication terminals will be connected to selector units of the nearest wide-band data acquisition unit. The selector units are used to connect terminals to audio data trunk lines that terminate at a switching matrix in an audio data handling unit. The audio data switching matrix is used to route signals between acquisition units, or between trunk lines and nearby, commonly used audio data handling equipment, such as the audio tape machines. An audio data handling equipment list is shown in Table II-5.

II.2.5 COMPUTER DATA HANDLING. The computer is the heart of the Data Management System, and has many data and control links with peripheral equipment. These links are summarized as follows:

a. PCM Data Control Unit (Refer to Figure II-2).

1. Direct Input/Output (DI/O) to PCM Data Formatter for setup and control to the formatter, and status to the computer.

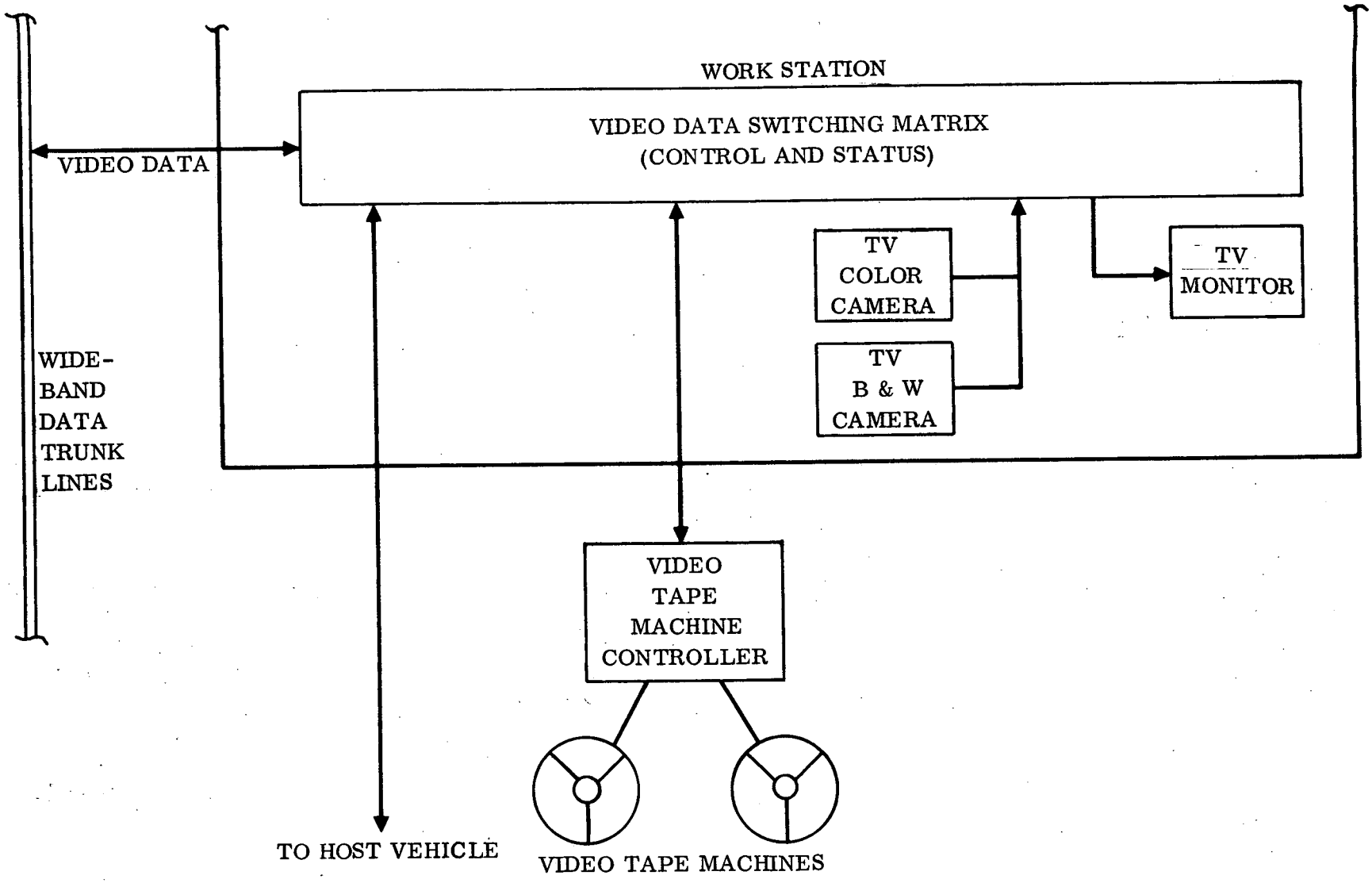


Figure II-7. Video Data Handling Unit - DMS

Table II-4. Video Data Equipment List - DMS

EQUIPMENT LIST	Weight kg (lbs.)	Volume m^3 (ft^3)	Power Watts	Quantity Per Payload			
				MINI-7	MINI-30	MAXI-NOM	MAXI-Max
Video Data Switching Matrix	2.0	.002	20	1	1	1	3
Video Tape Machine (2)	35.0	.113	400	1	1	1	1
Video Data Truck Lines (4)	4.0	.003	-	1	1	1	2
T.V. Camera - Color	20.0	.020	100	1	1	1	1
T.V. Camera - B & W	3.0	.010	25	1	1	1	2
T.V. Monitor	15.0	.030	50	1	1	2	3
Camera Commutator	2.0	.001	10	1	1	2	2
	Total Weight			81.0 (178)	81.0 (178)	98.0 (216)	122.0 (268)
	Total Volume			.179 (6.3)	.179 (6.3)	.210 (7.4)	.257 (9.1)
	Total Power			605	605	665	780

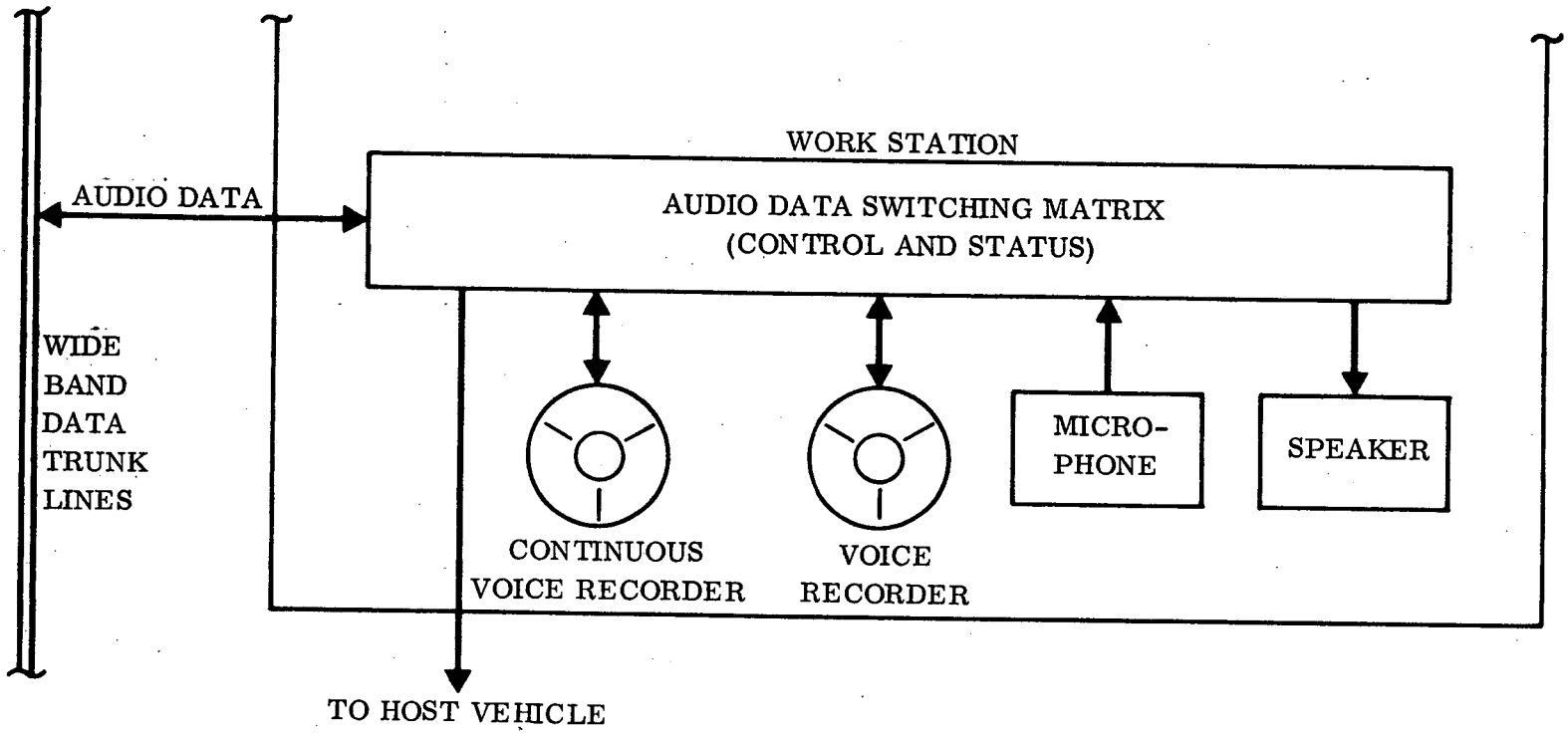


Figure II-8. Audio Data Handling Unit - DMS

Table II-5. Audio Data Equipment List - DMS

EQUIPMENT ITEM	Weight kg (lbs.)	Volume m^3 (ft^3)	Power Watts	Quantity Per Payload			
				MINI-7	MINI-30	MAXI-NOM	MAXI-MAX
Audio Data Switching Matrix	1.0	.001	10	1	1	1	3
Continuous Voice Recorder	2.5	.005	50	1	1	1	1
Portable Voice Recorder	2.5	.005	50	1	1	1	3
Audio Data Trunk Lines (4)	4.0	.003	-	1	1	1	2
Wireless Communication Set	1.0	.002	50	1	1	1	2
Stationary Communication Set	1.0	.002	20	1	1	2	3
	Total Weight			12.0 (26)	12.0 (26)	13.0 (29)	26.0 (57)
	Total Volume			.018 (.6)	.018 (.6)	.020 (.7)	.039 (1.4)
	Total Power			180	180	200	390

2. Direct Momory Access (DMA) to PCM Data Formatter and Common Data Bus Interface Unit, for PCM data requests to the formatter and common data bus.

3. DMA to PCM Data Formatter for PCM data to computer.

4. DI/O to Time Code Translator for time words and clocks to computer.

b. Analog Data Interface Unit (Refer to Figure II-5).

1. DI/O to Analog-to-Digital Multiplexer Programmer for setup and control to the programmer, and status to the computer.

2. DMA to Analog-to-Digital Converter for digitized analog data to computer.

3. DI/O to Digital-to-Analog Converter for computer data and control to the converter, and status to the computer.

c. Computer Data Transfer and Storage Unit (Figure II-9).

1. DI/O to Computer Data Transfer Controller for setup and control to the controller, and status to the computer.

2. DMA to Computer Data Transfer Controller for data transfer to and from controller.

3. DI/O to Computer Tape Controller for setup and control to controller, and status to computer.

4. DMA to Computer Tape Controller for data transfer to and from controller.

5. DI/O to Quick-Access Storage Controller for setup and control to controller and status to computer.

6. DMA to Quick-Access Storage Controller for data transfer to and from controller.

d. Computer Graphics Control Unit (Figure II-10).

1. DI/O to Control/Disp lay Bus Interface for setup, control and display data to interface; and status and data to computer.

2. DMA to Control/Display Bus Interface for display data from computer.

e. External Control Unit (Figure II-11).

1. DI/O to External Control Unit for setup, control and unscheduled control requests; and status to computer.

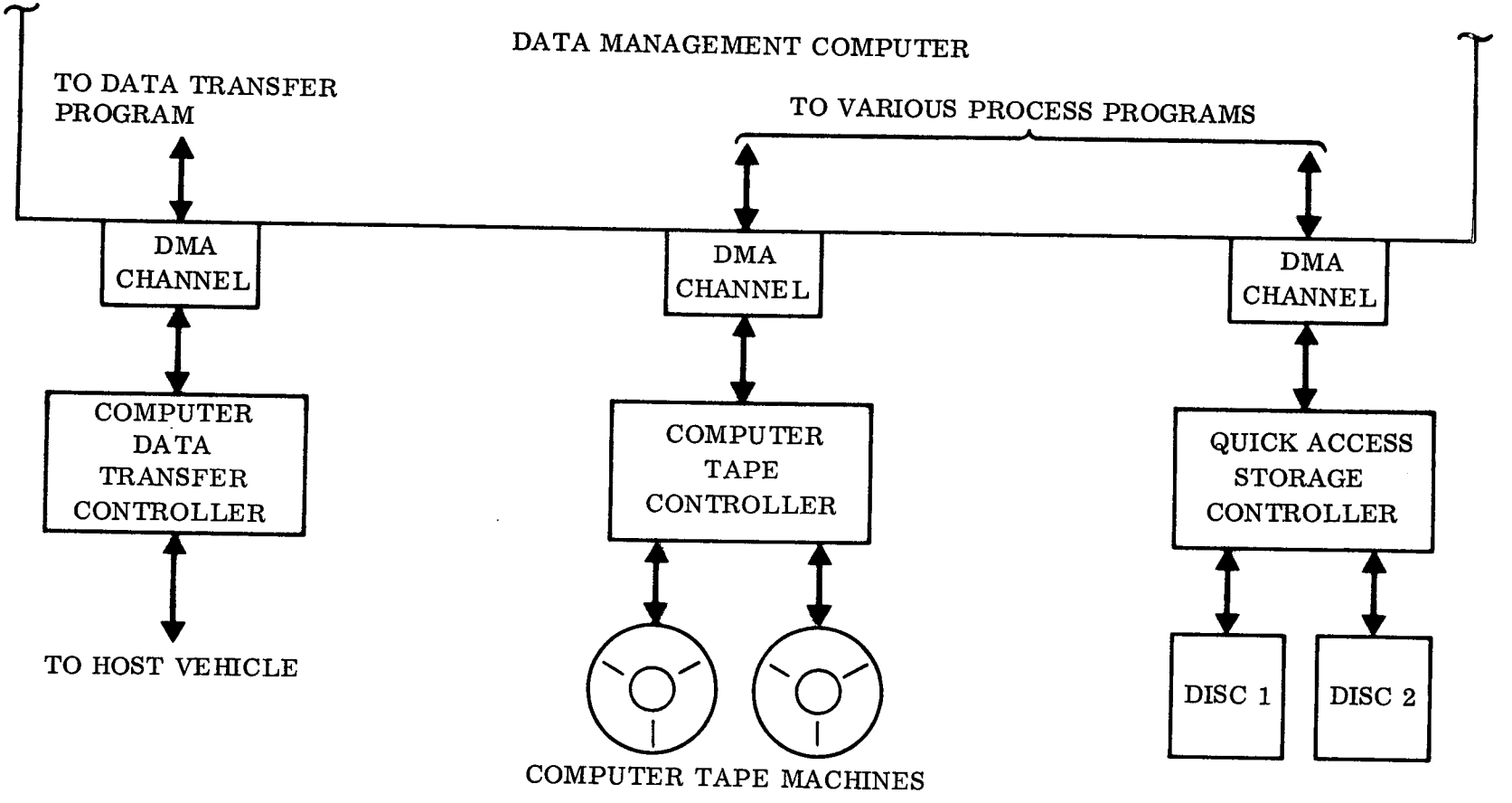


Figure II-9. Computer Data Transfer and Storage Unit - DMS

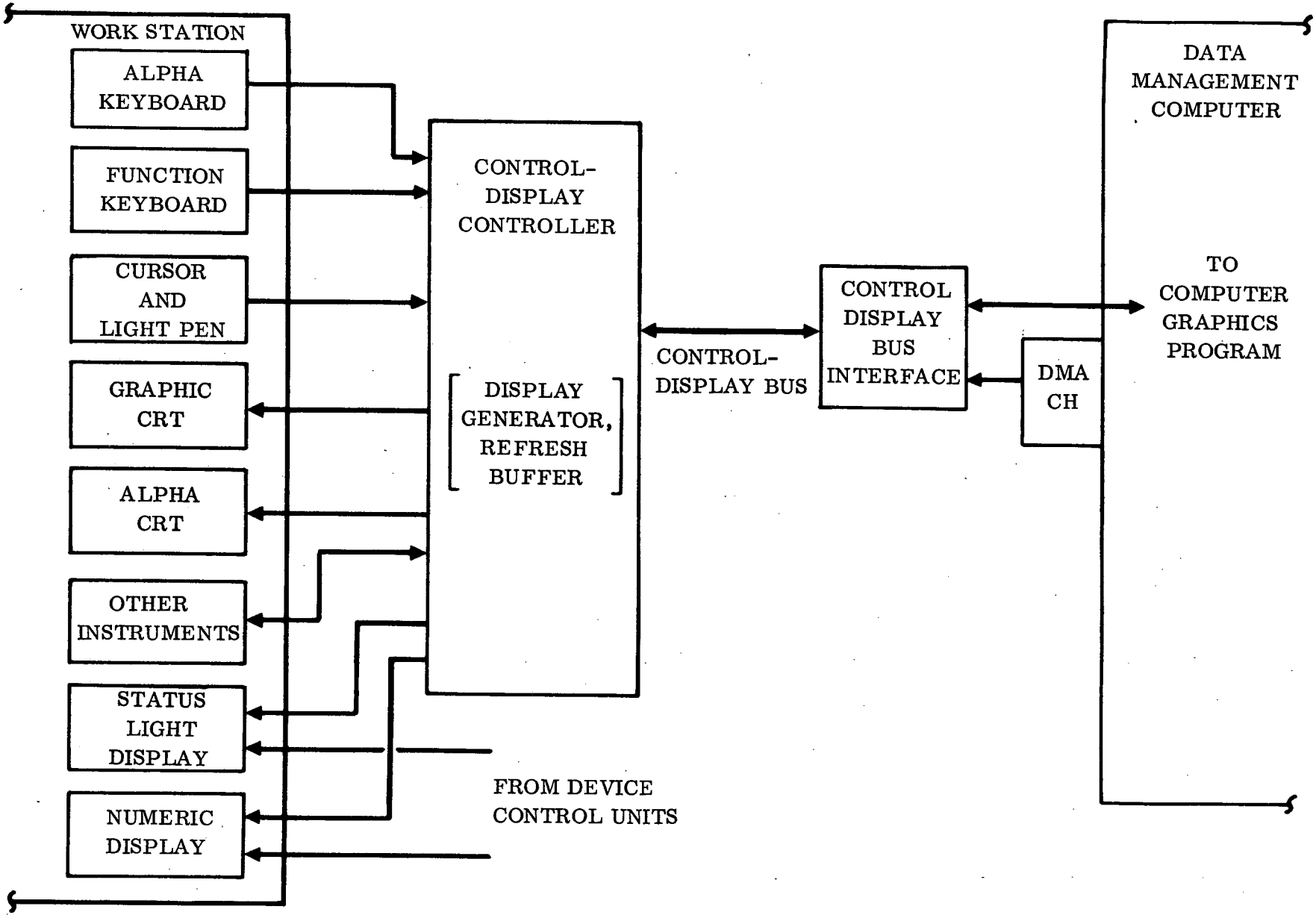
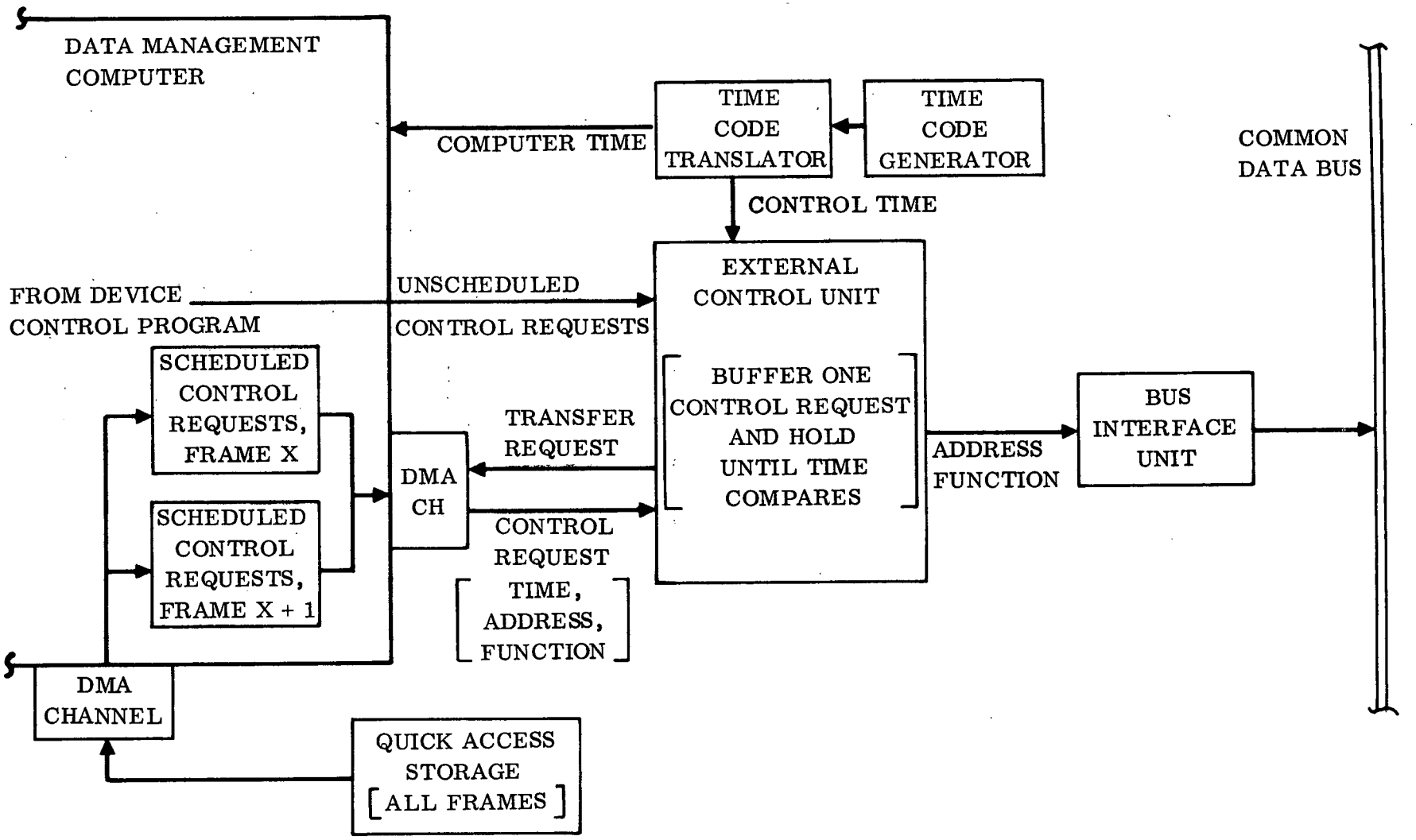


Figure II-10. Computer Graphics Control Unit - DMS



Figue II-11. External Control Unit - DMS

2. DMA to External Control Unit for scheduled control requests.

f. Other Links

1. Interrupts from above interfaced equipment, and miscellaneous other sources.

The functions of the computer when operating with the PCM Data Control Unit, Analog Data Interface Unit, and the External Control Unit are described in other sections of this report dealing with these units.

A hypothetical application for the Computer Data Graphics Control Unit is discussed below, and describe this systems' capabilities. Assume an experimenter wants to:

a. Monitor incoming ECG data during an experiment;

b. extract only the data during a representative interval;

c. perform a computer programmed waveform analysis on the extracted ECG data;

d. display results of the analysis in graphic form on a CRT;

e. add annotation to the CRT display;

f. store the CRT display on film;

g. store the raw data interval on tape as a computer data file; and

h. store the ECG analysis results in the quick-access storage as a computer data file.

The incoming data could enter the computer as part of the PCM data stream, or enter through the A/D converter, if acquired by the analog data handling system. The data could enter by both. Since ECG data are typically handled by the analog data handling system, it would be available at the analog data switching matrix. It is directed into the computer by using the Graphics Control Unit to setup the A/D multiplexer programmer and its associated DMA channel to the computer.

A graphics executive program is always resident in the computer to service the graphics control unit. To setup the analog data link to the computer, the experimenter gains the attention of this program by depressing a function key on the function keyboard. The executive program responds by displaying a

menu of available programs on an alphanumeric CRT. The experimenter points to the analog data acquisition program (included in the menu) with the light pen, and depresses its associated switch. The executive program then transfers the analog data acquisition program from the quick-access storage, and executes it. The acquisition program displays a menu of setup alternatives on the CRT. These include multiplexer channels to digitize, rate to digitize, and size of the analog data input buffer. The experimenter indicates his choice for these parameter using the light pen and switch. He then depresses a function key to start the operation. Thereafter the incoming digitized data stream repeatedly fills the analog data input buffer from top to bottom, automatically, under control of the A/D programmer and DMS channel.

The next step is transfer the special process program into the computer, to be used to process the data. This is done in the same manner as was used for the analog data acquisition program. The special process program will display a menu of setup alternatives on the CRT. Generally, the setup specifies the software linkages between the analog data input buffer, the special process program, and the graphics display program. Some setup parameters cannot be specified by selection from a predetermined menu. In this case the alphanumeric keyboard is enabled when the light pen indicates what parameter is to be setup. The information is entered from the keyboard, and displayed on the CRT. All selections made with the light pen are displayed. After he is satisfied that the setup is correct, the experimenter depresses a function key to start the operation.

The next step is to call the graphics display program, and specify its setup. This is done in the same manner as above. Many setup specifications are required. A basic graphic display format is chosen from a file of standard formats, and the keyboard is used to add annotations to the format. The format chosen is probably one to display a graphical time history. The time length of the displayed interval, the display scales, and the method used for "paging" the display frame are chosen. After he is satisfied that the setup is correct, the experimenter depresses a function key to start the operation. The incoming data are displayed on the CRT in real-time. Time is always available to the computer, and the time scale is updated for each new page.

The graphic display program enables, and is able to service, most of the control equipment of the computer graphics control unit. The experimenter is able to apply human judgments to the process by using the control equipment, primarily the function keys. In this example he monitors the incoming data being displayed on the CRT until he is ready to select a representative interval. Several methods are available to do this. One way is to depress a function key at the beginning, and at the end of the interval. Another way is to enter the start and stop time through the keyboard. The graphic display program automatically extracts this interval if a function key has "armed" this function of

the program. Another way is to enter the interval length and arm a function key that is depressed by the experimenter whenever he chooses to designate the start of an interval. A waveform analysis is performed on the extracted data by the special process program, the results of the analysis are displayed on the CRT, and both the raw data and results are temporarily stored until disposition is made by function key action. The experimenter probably would choose a display mode that would hold the extracted interval of raw data on the CRT. The results would be added to that display.

A function key is used to couple a slave CRT to the graphic CRT. The copied image on the slave CRT is recorded on film, by a camera fixed to the slave CRT for this purpose. Other function keys direct the data intervals to be stored in the medium specified.

Another example of the use of the graphics control unit is described below. In this example the experimenter wishes to review information previously stored by the computer. The file maintenance program is used.

This program maintains a complete file of all computer data files and has the subroutines to retrieve, display, modify, and store entries of most of these files. A typical use of the file maintenance program might be to replace an existing transducer calibration in the instrumentation file with a new entry. The station operator, using the function keyboard, initiates this action by requesting the graphics executive to display a menu of application programs on the alphanumeric CRT. The light pen is then positioned on the face of the CRT to select the file maintenance program.

The executive transfers the file maintenance program to CORE, and initiates its execution. The file maintenance program displays a menu of files on the CRT. The operator selects the instrumentation file as described above. The file maintenance program transfers the instrumentation file to CORE, displays the index or first page of the file on the CRT, and enables certain function keys. In general, the function keys are assigned general-purpose functions, which are used with many different application programs. All keys have status lights to indicate "enabled" or "active" status. In this example, the first desired function would possibly be to locate and display the current transducer calibration entry. This could be done in several ways. If the file is indexed, the entry could be selected using the light pen. Or, the file could be scanned a page (CRT display frame) at a time using the "page advance" function key. After the desired page is displayed, other function keys allow a light pen indicated entry on the page to be deleted, or another entry created on the alphanumeric keyboard to be inserted.

A computer data handling equipment list is shown in Table II-6.

Table II-6. Computer Data Equipment - DMS

EQUIPMENT ITEM	Weight kg (lbs.)	Volume m^3 (ft^3)	Power Watts	Quantity Per Payload			
				MINI-7	MINI-30	MAXI-NOM	MAXI-MAX
Computer Central Processing Unit	25.0	.025	60	1	1	1	1
Computer Core Storage, 32 K	15.0	.015	40	1	1	2	2
Computer Tape Machines (2)	35.0	.150	400	1	1	1	1
Quick-Access Storage (1 M words)	50.0	.150	600	1	1	1	2
Computer Data Transfer Unit	1.0	.002	20	1	1	1	1
Time Code Generator/Translater	2.5	.002	7	1	1	1	1
Common Data Bus. & Control	8.0	.010	30	1	1	1	1
Control/Display Bus. & Control	5.0	.004	30	1	1	1	1
Graphics Controller	8.0	.015	30	1	1	1	1
Alphanumeric Keyboard	1.0	.003	2	1	1	1	2
Function Keyboard	1.0	.003	4	1	1	1	2
Cursor and Light Pen	.5	.001	2	1	1	1	1
Graphic CRT	15.0	.070	50	1	1	1	2
Alphanumeric CRT	12.0	.050	40	1	1	1	3
Status Light Display (80)	1.5	.003	10	1	1	1	3
Numeric Display (5×10)	1.5	.003	10	1	1	2	3
Slave CRT and Camera	15.0	.070	50	1	1	1	1
Total Weight				195.0 (430)	195.0 (430)	211.5 (464)	307.0 (675)
Total Volume				.476 (16.8)	.476 (16.8)	.494 (17.5)	.829 (29.3)
Total Power				1385	1385	1435	2201

II.2.6 MISCELLANEOUS DATA HANDLING. A list of miscellaneous data handling equipment is shown in Table II-7. Most of items in the list are general purpose cameras.

II.3 COMPUTER CONTROL OF DEVICES

Capabilities of the computer to control devices are illustrated by the External Control Unit shown in Figure II-11. The Device Control Unit is shown in Figure II-12. Computer control of equipment is provided by a device control program executed in the computer, and an associated external control unit peripheral to the computer. Modification, and initial execution of this program is by operator control. During initial execution, a DMA channel of the computer and the external control unit are "setup". Thereafter all device control operations proceed automatically, under control of the DMA channels and external control unit.

During initial execution of the device control program, the first device control request is transferred from the computer to the device control unit. A device control request is actually a function code, an address of a device control unit and one of its associated demultiplexer channels, and time. In other words, the address of the device, and the time when the control is to be executed. During normal operation, the device control unit holds the next control request to be executed. It continuously compares current time with the time specified in the request. When these match, the control request is outputed to the common data bus, via a bus interface unit, and is received by the addressed device via its device control unit.

After the external control unit disposes of its current request, it issues a transfer request to the control request output DMA channel. The DMA channel accesses the control request buffer (in computer core storage) for the next control request, and outputs it to the external control unit. Two control request buffers are used. The buffers are alternately emptied by the control request DMA channel, and alternately filled by the control file DMA channel. The size of a request buffer is defined as a control frame. The size of the control request file is a multiple of the request buffer size, and is defined as a control cycle. There are no hardware limitation, as to how often one device is activated relative to another, or in the order that they are activated. These are software functions, and are determined solely by how often and in what sequence the control requests appear in the request file.

When the last control request of a frame in the control request buffer has been transferred out, the DMA channel issues an end-of-range interrupt to the computer. The computer then directs the DMA channel to the other buffer and initiates updating of the recently completed buffer.

Table II-7. Miscellaneous Data Equipment List - DMS

EQUIPMENT ITEM	Weight kg	Volume m^3	Power Watts	Quantity Per Payload			
				MINI-7	MINI-30	MAXI-NOM	MAXI-MAX
Polaroid Camera	1.3	.001	-	1	1	1	4
Roll Film Camera	2.3	.003	-	1	1	1	1
Movie Camera	.5	.008	-	1	1	1	1
Plate Film Camera	1.3	.002	-	1	1	1	1
Misc. Signal Conditioners	1.3	.002	5	1	1	1	2
	Total Weight			6.7 (15)	6.7 (15)	6.7 (15)	11.9 (26)
	Total Volume			.015 (.53)	.015 (.53)	.015 (.53)	.020 (.71)
	Total Power			5	5	5	10

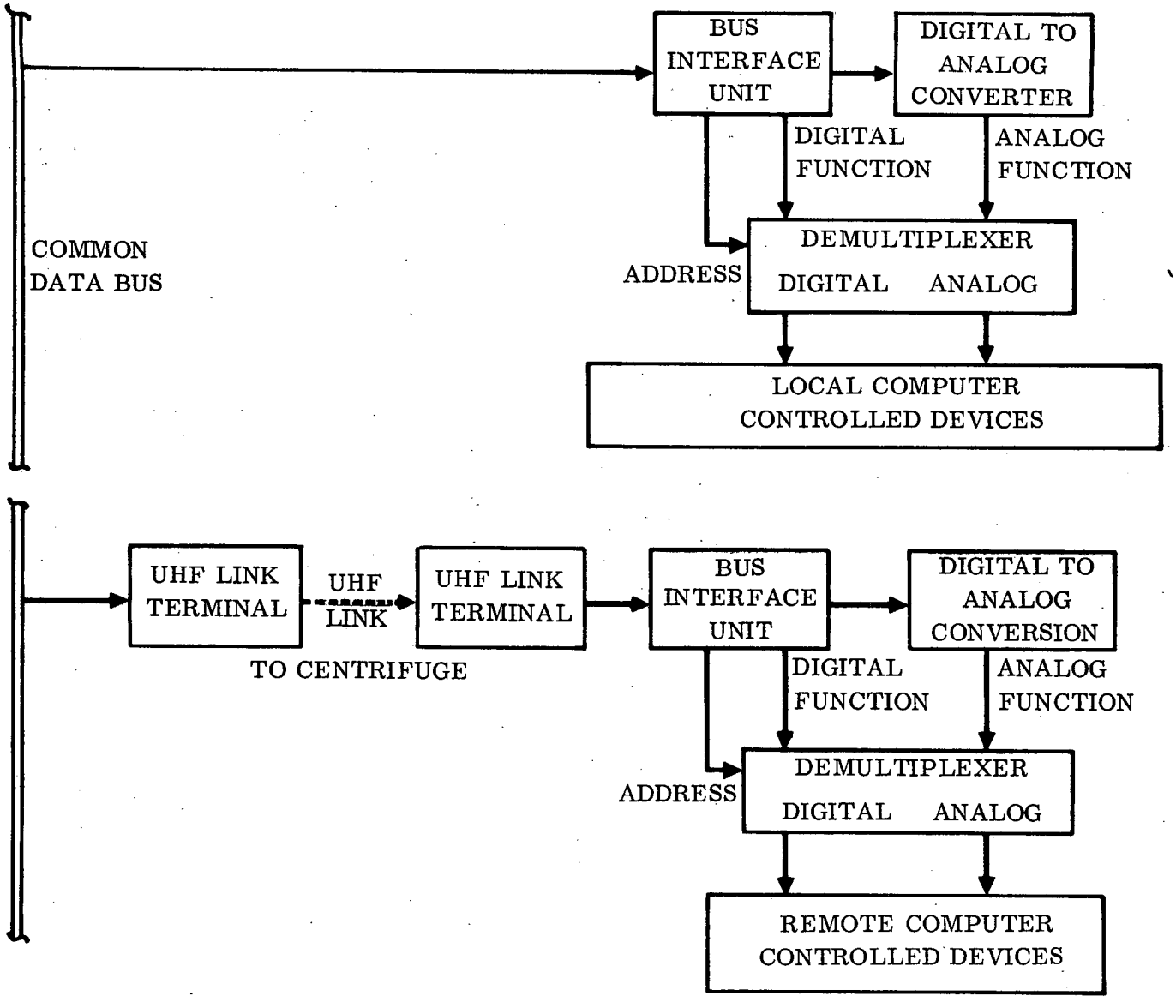


Figure II-12. Device Control Unit - DMS

The above described operation serves to control devices on a time-scheduled basis only. This is useful for experiements that are well planned in advance, and require a scheduled cyclic operation of equipment. However, equipment control for many applications cannot be scheduled. When a device is to be activated, will depend upon some predetermined criteria being met, which might be sensed by a processing program from incoming data. Or, the pace of equipment operation must be under control of an experimenter. For this reason, the external control unit has the capability to issue unscheduled control requests. These requests are transferred directly to the external control unit by any processing program. These requests are acted upon immediately, but do not disrupt the scheduled operations. Several processing programs can time-share the computer, each issuing control requests independently of the others. A computer device control equipment list is shown in Table II-8.

II.4 ALTERNATIVE APPROACHES

Many trade-offs must be considered, and resolved before a firm configuration can be selected for the Data Management System. During this contract, the approach used was to define the independent equipment necessary to satisfy the Life Sciences payload with minimum constraints imposed by the supporting vehicle and mission. This was discussed in Appendix, where it was pointed out that the next recommended follow-on phase to this study would investigate the interface and integration aspects of the preliminary designs presented herein. It is anticipated that the Data Management System penalties presented in the preceeding section could be substantially reduced as a result of such studies. Several aspects of such integration are as follows:

a. Share a Data Management System with other payloads. The DMS sized for the Maxi Nom payload could provide data management services to other FPE payloads similar to the Life Sciences Mini-7. Figure II-13 shows curves (solid lines) for weight, volume, and power required for data management equipment listed for each of the four payloads as a function of the length of the module required. The lists were compiled under the assumption that all basic DMS capabilities would be included for small payloads. The solid curves indicate unrealistically high DMS loads for the small payloads. The dotted curves have the shape one would expect, and are probably reasonable estimates to use for DMS properties, assuming a DMS shared by other than Life Science payloads.

b. Use some data management functions available on board the support modules. The weight, volume, and power requirements of the DMS presented herein could be considerably reduced if some of its functions are provided by the support module. The data storage function (for data never, or seldom, retreived for on-board use) could be moved to the support module. This would move two instrumentation tape machines, two video tape

Table II-8. Computer Device Control Equipment List - DMS

EQUIPMENT ITEM	Weight kg (lbs.)	Volume m^3 ($ft.^3$)	Power Watts	Quantity Per Payload			
				MINI-7	MINI-30	MAXI-NOM	MAXI-MAX
External Control Unit	4.0	.005	20	1	1	1	1
Device Control Unit	2.0	.003	10	3	4	6	12
	Total Weight			10.0 (22)	12.0 (26)	16.0 (35)	28.0 (62)
	Total Volume			.014 (.49)	.017 (.60)	.023 (.81)	.041 (1.45)
	Total Power			50	60	80	140

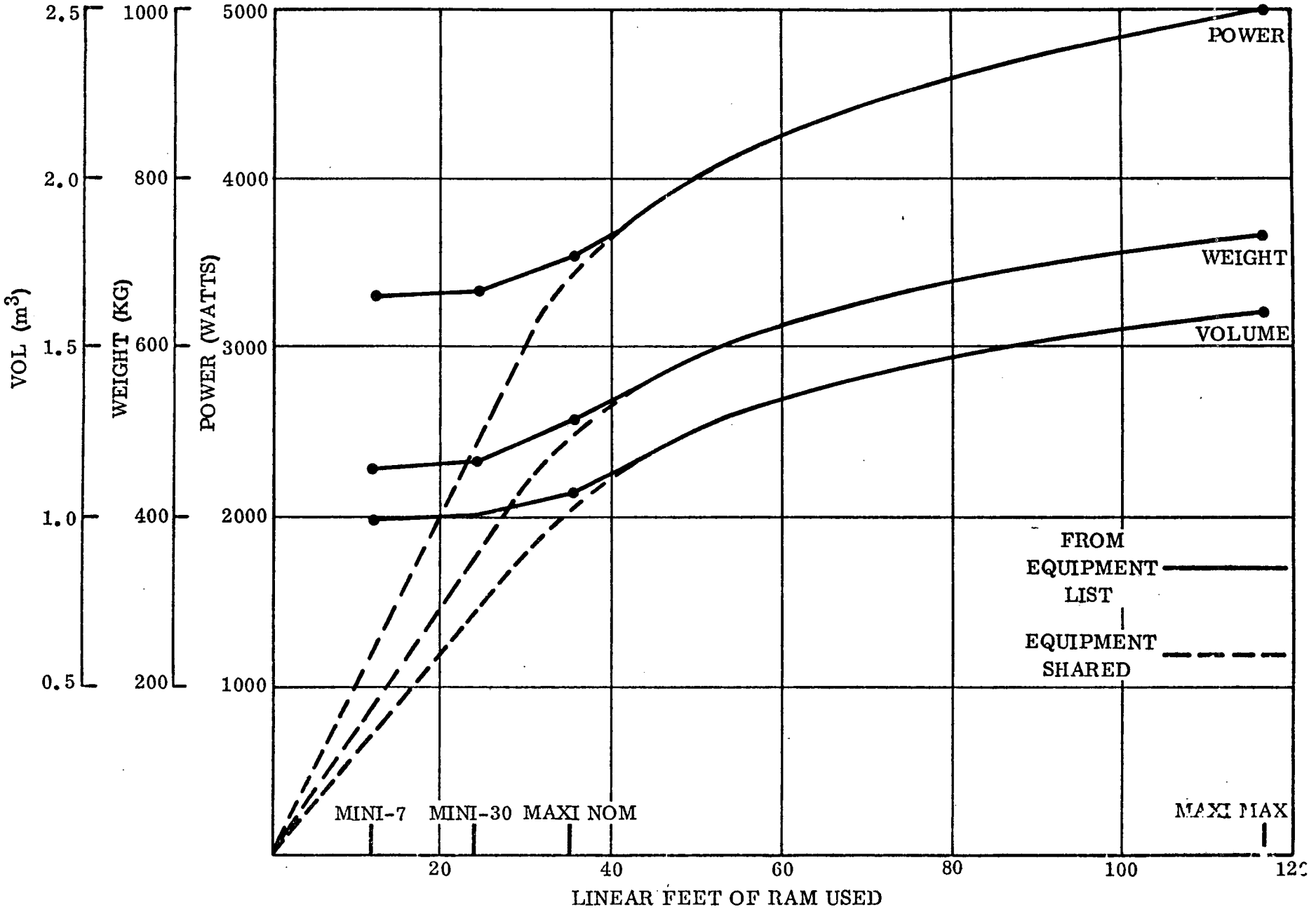


Figure II-13. Data Management System Requirements - Weight, Volume, Power

machines, two computer tape machines, and one audio tape machine to the support module. The portable audio tape machine, and the loop analog tape machine would not be moved. The DMS weight would be reduced by 129 Kg, volume by 0.346 m^3, and power by 1250 watts. This represents a more than one-third reduction in the case of the Mini-7 payload, and almost one-fourth for Maxi Max.

It appears unlikely that the data management computer could be moved to the support module and still retain the flexibility that a dedicated computer would also have to be moved, or their interfaces designed to operate through a common data bus. Some equipment, such as the computer graphics control unit, must be located in the experimenter work area.

c. Provide experiment setup, monitoring, control, data processing, and analysis using ground facilities. The DMS presented herein provides audio, analog, video, and computer data links to the support module that can be used for real-time data, or command transmission. Command and control data are transferred from the support module as computer data files. However, if the function of experiment setup, monitoring, control, data processing, and data analysis are to be handled primarily by ground facilities continuously in real-time (or nearly so), then; the DMS should be tailored for this mode of operation. This mode would require more automation of such functions as signal switching. A communication system might have to be added. Data storage requirements would probably be reduced. However, an automatic, short-term, continuous "fill and dump" capability might be required. Much of the signal monitoring and computer graphics capability would not be required. Communication satellites would probably have to be used.

d. Use of the same common data bus system for the Life Science DMS, RAM, SS, and Shuttle, was not discussed in detail in the functional description of the DMS. Candidate common data bus systems are being studied under other current contracts for RAM and Shuttle. For the sake of commonality, the system chosen for these vehicles should be used. The DMS organization presented herein is intended to be independent of the bus system used.

APPENDIX III

CREW AND EQUIPMENT OPERATIONS ANALYSIS

This appendix contains the operations model (Section III-1) and the equipment operations analysis (Section III-2), which are the basis for the crew and equipment research analyses discussed in Section 2.3, Volume II.

III.1 OPERATIONS MODEL

The Life Sciences payloads are based on the "Facility Approach", and consequently there are no specific experiments scheduled to be conducted within the laboratory. In order to make preliminary estimates of experiment/schedule-dependent factors; such as average power requirements, crew size and skill requirements, passageway/workspace volume requirements, and ECS requirements, it is necessary to develop an operations model upon which these estimates can be based. This model consists of each of the functions to be performed within the laboratory, and an estimate of the frequency of occurrence of each. These frequencies are xonsidered to be reasonable estimates of the character of the operations within the Maxi Max laboratory. Average frequencies have been assumed for sporadic functions; that is, functions that occur quite frequently for a period, then not at all for a subsequent period.

The functions and their assumed frequencies are grouped in the following categories and presented in Table III-1.

a. Experiment Measurements and Analysis

b. Support Operations

c. Speciment Maintenance

d. Equipment Maintenance.

The types of operations associated with the above categories are manual, semiautomatic, and automatic.

freq	=	expected frequency	mo	=	month
hr (hrs)	=	hour(s)	c	=	continuous operation
dy (dys)	=	day(s)	as re'q	=	as required
wk (wks)	=	week(s)			

Table III-1. Operations Model Maxi Max Payload

1. EXPERIMENT MEASUREMENTS AND ANALYSIS

MANUAL AND SEMIAUTOMATIC

9 1 ORGANISM MASS MEASUREMENTS
9 FREQ - 30/90 DYS

17 11 MONITOR ECG (FOR BIORESEARCH - ECG SIGNAL MGMT FROM CAGE TO CAGE
17 21 MOD TO DATA MGMT.)
17B FREQ - 3/WK - HARDWIRE MULTIPLEX DATA TO DM (CREW CK FREQ)
17C FREQ - 2/WK - XMTR ON ORGANSM/RECVR AT CG MOD
17F FREQ - 6/WK - ELECTROPHYSIOLOGY BACKPACK-MAN

18 11 MONITOR EEG (FOR BIORESEARCH - EEG SIGNAL MGMT FROM CAGE TO CAGE
18 21 MOD TO DATA MGMT.)
18B FREQ - 3/WK - HARDWIRE MULTIPLEX DATA TO DM (CREW CK FREQ)
18C FREQ - 2/WK - XMTR ON ORGANSM/RECVR AT CG MOD
18F FREQ - 3/WK - ELECTROPHYSIOLOGY BACKPACK-MAN
18G FREQ - 3/DY - DISCRETE MONITORING UNITS-MAN-PORTABLE
18H FREQ - 2/WK - ELECTROPHYSIOLOGY CONSOLE-MAN-FIXED SYS

19 1 MONITOR EMG-EMG SIGNAL MGMT CAGE TO CAGE MOD TO DATA MGMT

Table III-1. Operations Model Maxi Max Payload, Contd

```
19B       FREQ -  3/WK - HARDWIRE MULTIPLEX DATA TO DM (CREW CK FREQ)
19C       FREQ -  2/WK - XMTR ON ORGANSM/RECVR AT CG MOD
19F       FREQ -  3/WK - ELECTROPHYSIOLOGY BACKPACK-MAN

20  1 RESPIRATORY  RATE MONITORING- DOES NOT INCLUDE RESP VOLUME
20B       FREQ - 12/WK - PLYTHESMOGRAPH ON ORGANISM

21  1 CARDIAC OUTPUT- IMPLANTED FLOW XDCR-SIGNAL XFR TO DM AS FUNC 17
21A       FREQ -  3/WK - CATHETERIZED SEMIRESTRAINED
21B       FREQ -  2/WK - ULTRASONIC FLOWMETER

24  1 WATER CONSUMPTION -WATER CONSUMED OR WATER DELIVERD
24B       FREQ - 10/WK - VOL OR MASS OF WATER BAG/BOT

26  1 LIQUID VOLUME MSMTS- MICRO VOLUMES  .001 ML TO 1 ML
26A       FREQ -  3/DY - MICROPIPETTES
26B       FREQ -  4/DY - MICROSYRINGES

27  1 LIQUID VOLUME MSMTS- MACRO  1 ML TO 1000 ML
27        FREQ - 15/DY

28  1 MASS MEASUREMENTS OF CONTAINED LIQUIDS AND SOLIDS - .001-100 GRAMS
28        FREQ -  6/DY

29  1 MASS MEASUREMENTS- CONTAINED LIQUIDS AND SOLIDS   - 10-1000 GRAMS
29        FREQ -  9/DY

30  1 GROSS ANATOMIES-ASSESSMENT OF MAJOR ORGANS-SIZE SHAPE MASS COLOR
30        FREQ -  3/WK

34  1 BLOOD ELECTROLYTES
34B       FREQ - 20/WK - ATOMIC ABSORPTION
34C       FREQ - 20/WK - PRESERVE FOR GROUND ANALYSIS

35  1 BLOOD PH PCO2 O2    MSUR CONC OF DISSOLVED GS IN BLOOD
35        FREQ - 20/WK

36  1 BLOOD TOTAL PROTEIN  MSUR CONC IN SERUM OR WHOLE BLOOD
36C       FREQ - 10/WK - PRESERVE FOR GROUND ANALYSIS
36D       FREQ -  2/WK - ELECTROPHORESIS

39  1 THYROID FUNCTION TESTS-SERUM STABLE WHEN IF ALL CELLS REMOVED
39        FREQ -  6/WK

40  1 BLOOD MORPHOLOGY AND CELL COUNTS
40        FREQ - 20/WK

41  1 HEMATOCRIT  MSUR OF PACKED CELL VOL TO TOTAL VOL
41        FREQ -  4/WK

42  1 HEMOGLOBIN-MSUR CONC OXYHGB OR CARBOXYHGB
42        FREQ -  4/WK

45  1 RBC OMOTIC FRAGILITY-MSUR RUPTURE PRESSURE OF RBC
45        FREQ -  4/WK

47  1 IMMUNOGLOBIN ASSAY- MSUR ANTIBODY FORMATION
47B       FREQ -  2/WK - DISC GEL ELECTROPHORESIS
47C       FREQ -  2/WK - PRESERVE FOR GROUND ANALYSIS

48  1 ANTIBODY TITRATION-DETERMINE ANTIBODY CONC TO SPECIFIC DISEASE
```

Table III-1. Operations Model Maxi Max Payload, Contd

```
 48A       FREQ -  2/WK - INTERFACIAL TEST IN AGAR
 48B       FREQ -  2/WK - PRESERVE FOR GROUND ANALYSIS

 49  1 PRESSURE MONITORING
 49A       FREQ -  3/DY - METERS VISUAL READOUT

 51  1 TRACE GAS ANALYSIS HYDROCARBONS-SPECIFIC COMPOUND/PREDETERM LIST
 51A       FREQ - 20 MIN/DY - GAS CHROMATOGRAPHY
 51B       FREQ -  2/DY - MASS SPECTROSCOPY
 51C       FREQ -  2/DY - INFRARED ABSORPTION

 53  1 OXYGEN MONITORING
 53A       FREQ -  2/DY - POLAROGRAPHIC SENSOR

 57  1 WATER VAPOR MONITORING
 57C       FREQ -  2/DY - SPECIFIC SENSORS

 63  1 RADIATION MONITORING AT ORGNSM HOLDNG AND THROUGHOUT LAB
 63A       FREQ -  1/WK FOR EA OF 110 BADGES - FILM SENSORS
 63C       FREQ -  1/MO - RATE MONITORING

 69  1 CARBOHYDRATE ANALYSIS-SOLUABLE/INSOLUABLE
 69        FREQ -  5/WK

 78  1 INVERTEBRATE COUNTING AND SORTING  (INSECTS)
 78        FREQ - 30 MIN/DY

 85  1 STARCH GRANULE ASSAY
 85        FREQ -  2/WK

 86  1 BACTERIAL COLONY COUNTING
 86        FREQ - 10/WK

 87  1 MICROORGANISM IDENTIFICATION
 87        FREQ - 15/WK

 91  1 PLANT RADIOCHEMISTRIES
 91        FREQ - 16/2 WKS

 92  1 VERTEBRATE RADIOCHEMISTRIES
 92        FREQ - 16/2 WKS

 93  1 INVERTEBRATE RADIOCHEMISTRIES
 93        FREQ - 16/2 WKS

 94  1 CELLS AND TISSUE RADIOCHEMISTRIES
 94        FREQ - 16/2 WKS

108  1 BACTERIAL CELL COUNTING
108A       FREQ -  3/WK - AUTOMATIC CELL COUNTERS
108B       FREQ -  2/WK - HEMATOCRIT
108C       FREQ -  3/MO - VITAL STAINING

141  1 AIRPARTICULATE SAMPLING AND ANALYSIS
141        FREQ -  2/DY

149  1 URINE ANALYSIS
149A       FREQ -  1/WK (SETUP) - AUTOMATIC URINE ANALYSIS
149C       FREQ -  5/WK - PRESERVE FOR GROUND ANALYSIS

155  1 URINARY PHOSPHATES
```

Table III-1. Operations Model Maxi Max Payload, Contd

```
155        FREQ - 16/WK

156  1 URINE CREATININE AND CREATINE
156        FREQ - 16/WK

161  1 ARTERIAL BLOOD PRESSURE
161        FREQ -  5X3/3 DYS

162  1 X-RAY DIAGNOSTIC
162        FREQ -  5/2 DYS

164  1 PERIPHERAL VENOUS BLOOD PRESSURE
164        FREQ -  5/WK

166  1 LINEAR MEASUREMENTS
166        FREQ - 15 MIN/WK

170  1 TV MONITORING AD HOC -COMMERCIAL GRADE COLOR
170        FREQ -  1 HR/DY

173  1 PLANT LIPIDS
173        FREQ -  5/MO

174 11 ENZYME ASSAY-RECOMMEND ASSAYS POSSIBLE ON CRUDE HEMOGENATES AND
174 21 ONE STEP PARTIAL PURIFICATION ONLY FOR SPACE ANAL
174        FREQ -  5/MO

175  1 AMINO ACIDS ASSAY
175A       FREQ - 15 MIN/MO - AUTOMATIC ANALYSIS
175B       FREQ -  5/MO - PRESERVE FOR GROUND ANALYSIS

177  1 PROTEIN ASSAY
177B       FREQ -  5/WK - PRESERVE FOR GROUND ANALYSIS
177D       FREQ -  3/WK - AUTOMATIC BIOCHEMICAL ANALYZER

180  1 PLANT HORMONES
180A       FREQ -  3/2 WKS - CHROMATOGRAPHY
180B       FREQ -  5/2 WKS - PRESERVE FOR GROUND ANALYSIS

226  1 CELLS AND TISSUE POPULATION DENSITY
226        FREQ -  5/DY

304  1 LOWER BODY NEGATIVE PRESSURE (LBNP)
304        FREQ -  7/WK

306  1 EAR CANAL CALORIC STIMULATION
306        FREQ -  3/WK

307  1 SPATIAL LOCALIZATION
307        FREQ -  3/WK

308  1 ELECTRO-OCULOGRAM (EOG)  0.14-100HZ   A-D  AT LEAST 500 SAMP/SEC
308B       FREQ -  3/DY

315  1 TOTAL BODY WATER
315        FREQ -  1/WK

316  1 AGRAVIC PERCEPTION
316        FREQ -  3/WK

317  1 OCULAR COUNTER-ROLLING
```

Table III-1. Operations Model Maxi Max Payloads, Contd

```
317        FREQ -  3/WK

318  1 OCULOGYRAL ILLUSION
318        FREQ -  3/WK

319  1 VECTORCARDIOGRAM  (VCG)  0.05-500HZ   A-D  AT LEAST 2500 SAMP/SEC
319A       FREQ -  3/3 DYS     - DISCRETE MONITORING UNITS-MAN
319B       FREQ -  3/3 DYS     - ELECTROPHYSIOLOGY BACKPACK-MAN

320 11 PHONO/VIBROCARDIOGRAM (PCG/VBCG)  0.1-20HZ 10-30HZ  30-500HZ AND
320 21   0.1-1000HZ SELECTABLE --- A-D AT LEAST 100, 150, 2500, 5000
320 31  SAMPLES/SEC RESPECTIVELY
320A       FREQ -  3/3 DYS     - DISCRETE MONITORING UNITS-MAN
320B       FREQ -  3/3 DYS     - ELECTROPHYSIOLOGY BACKPACK-MAN

321  1 IMPEDANCE CARDIOGRAPHY (ZCG)       A-D  100 SAMPLES/SEC
321A       FREQ -  3/3 DYS     - DISCRETE MONITORING UNITS - MAN
321B       FREQ -  3/3 DYS     - ELECTROPHYSIOLOGY BACKPACK- MAN

322  1 VENOUS BLOOD PRESSURE -INVASIVE DURING VENIPUNCTURE
322        FREQ -  6/2 WKS

324  1 PULSE WAVE VELOCITY
324        FREQ -  4/2 WKS

325  1 PULSE WAVE CONTOUR
325        FREQ -  2/WK

326  1 BALLISTOCARDIOGRAPHY  (BCG)  AT LEAST 800 SAMPLES PER SEC
326A       FREQ -  3/WK        - DISCRETE MONITORING UNITS MAN
326B       FREQ -  3/WK        - ELECTROPHYSIOLOGY BACKPACK-MAN

327 11 RESPIRATORY VITAL CAPACITY (VC),TIMED VITAL CAPACITY (VC1,VC3)
327 21  INSPIRATORY CAPACITY (IC),EXPIRATORY RESERVE VOLUME (ERV)
327 31  TIDAL VOLUME (TV) MINUTE TIDAL VOLUME (MTV) MAX INSPIRATORY
327 41  FLOW (MIF),MAX EXPIRATORY FLOW (MEF) MAX BREATHING CAPACITY (MBC)
327 51  A-D  AT LEAST 200 SAMPLES/SEC
327        FREQ -  6/2 WKS

328  1 ALVEOLAR PO2
328        FREQ -  6/2 WKS

329  1 ALVEOLAR PCO2
329        FREQ -  6/2 WKS

330  1 RESPIRATORY DEAD SPACE (VD) ALVEOLAR VENTILATION (VA) RESIDUAL VOL (VR)
330        FREQ -  6/2 WKS

331  1 RESPIRATORY AIRWAY RESISTANCE (RA)
331        FREQ -  6/2 WKS

332  1 LUNG COMPLIANCE                        A-D AT LEAST 100 SAMP/SEC
332        FREQ -  6/2 WKS

333  1 BLEEDING TIME
333        FREQ -  2/2 WKS

334  1 CLOTTING TIME
334        FREQ -  2/2 WKS

335  1 ERYTHROCYTE SURVIVAL
```

Table III-1. Operations Model Maxi Max Payload, Contd

```
335         FREQ -  6/MO

336   1 PLASMA GLUCOSE
336         FREQ -  6/WK

337   1 PLASMA PHOSPHATE
337         FREQ -  6/WK

338   1 PLASMA ALKALINE PHOSPHATASE
338         FREQ -  6/WK

339   1 PLASMA BILIRUBIN
339         FREQ -  6/WK

340   1 PLASMA GLOBULINS
340         FREQ -  6/WK

342   1 PLASMA COAGULATION
342         FREQ -  6/WK

343   1 BODY MASS MEASUREMENT DEVICE (BMMD) FOR MAN
343         FREQ -  6/DY

344   1 ELECTRONYSTAGMOGRAM  (ENG)
344A        FREQ -  3X10 MIN/3 DYS - DISCRETE MONITORING UNITS-MAN
344B        FREQ -  3X10 MIN/3 DYS - ELECTROPHYSIOLOGY BACKPACK-MAN

345   1 ANGULAR ACCELERATION THRESHOLD
345         FREQ -  3/WK

346   1 SUBJECT HISTORIES
346A        FREQ -  12X1 MIN/DY    - VOICE RECORDING
346B        FREQ -  12X1 MIN/DY    - PRINTED FORMS AND NOTEBOOK

347   1 INTRAOCULAR PRESSURES
347         FREQ -  6/2 WKS

348   1 GONAD HISTOPATHOLOGY
348         FREQ -  6/2 WKS

350   1 CREW METABOLIC RECORDS -FOOD/WATER CONSUMPTION-URINE/FECES PRODUCTION
350A        FREQ - 12X1 MIN/DY     - LABORATORY NOTEBOOK
350B        FREQ - 12X1 MIN/DY     - VOICE RECORDS

351   1 BONE DENSITOMETRY- PHOTON ABSORPTION
351         FREQ -  3/2 WKS

352   1 RADIOISOTOPE COUNTING-WHOLE BODY
352         FREQ -  3/2 WKS

353  11 CULTURE/SENSITIVITY- MICROORGANISM GROWTH CAPABILITY IN PRESENCE
353  21   OF VARIOUS ANTIBIOTICS
353         FREQ -  6/3 WKS

354   1 EAR CANAL TEMPERATURE
354         FREQ -  6/3 WKS

355   1 MUSCLE STRENGTH AND SIZE
355         FREQ -  6/3 WKS

357   1 GASTRIC PRESSURE AND PH
```

Table III-1. Operations Model Maxi Max Payload, Contd

```
357         FREQ - 2/WK

359   1 HEART RATE
359         FREQ - 5 MIN/DY

362   1 URINE SEROTONIN AND ALDOSTERONE
362         FREQ - 6/WK

364   1 VISUAL TASK WITH HEAD ROTATION
364         FREQ - 3/WK

365   1 VENOUS COMPLIANCE (LVMS)
365         FREQ - 6/WK

366   1 ARTERIOLAR REACTIVITY
366         FREQ - 30 MIN/WK

370   1 VIRAL CULTURING
370         FREQ - 6/2 WKS

371   1 VIRAL IDENTIFICATION
371         FREQ - 6/2 WKS

372   1 FUNGAL CULTURING
372         FREQ - 6/2 WKS

373   1 FUNGAL IDENTIFICATION
373         FREQ - 6/2 WKS

501   1 ANALYSIS OF GAS MIXTURES FOR O2,N2,CO2,CO,CH4,H2O,H2,NH3,ETC
501A        FREQ - 2/DY      - CHROMATOGRAPHY
501B        FREQ - 2/DY      - MASS SPECTROSCOPY
501C        FREQ - 2/DY      - IR ABSORTION
501E        FREQ - 2/DY      - INDIVIDUAL CONSTITUENT SENSORS

503   1 WATER ANALYSIS -CONDUCTIVITY MEASUREMENT
503         FREQ - 1/4 HRS

504   1 WATER ANALYSIS - PH MEASUREMENT (H2 ION CONCENTRATION)
504         FREQ - 1/4 HRS

505   1 WATER ANALYSIS - TOTAL SOLIDS CONTENT
505         FREQ - 1/DY

506   1 WATER ANALYSIS - BACTERIOLOGICAL ASSAY
506         FREQ - 1/DY

511   1 ELECTRICAL CONTNUITY AND VOLTAGE MEASUREMENTS
511         FREQ - 3 MIN/WK

512   1 ELECTRICAL AMPERAGE MEASURMENTS
512         FREQ - 1/HR

522   1 VARIATION AND MEASUREMENT OF METABOLIC RATE OF SUITED CREWMAN
522         FREQ - 3/WK

700   1 VISUAL - ACUITY, STATIC - NEAR AND FAR                    BEIH
700         FREQ - 3/WK

701   1 VISUAL - ACUITY, DYNAMIC                                    H
701         FREQ - 3/WK
```

Table III-1. Operations Model Maxi Max Payload, Contd

702	1	VISUAL - STEREOPSIS (DEPTH PERCEPTION), STATIC	BEIH
702		FREQ - 3/WK	
703	1	VISUAL - STEREOPSIS (DEPTH PERCEPTION), DYNAMIC	H
703		FREQ - 3/WK	
704	1	VISUAL - BRIGHTNESS THRESHOLD, ABSOLUTE	BEI
704		FREQ - 3/WK	
705	1	VISUAL - BRIGHTNESS DISCRIMINATION	H
705		FREQ - 3/WK	
706	1	VISUAL - COLOR PERCEPTION	BEIH
706		FREQ - 3/WK	
707	1	VISUAL - CRITICAL FLICKER FUSION FREQUENCY	BEI
707		FREQ - 3/WK	
708	1	VISUAL - PHORIAS, LATERAL AND VERTICAL - NEAR AND FAR	BEI
708		FREQ - 3/WK	
709	1	VISUAL - GLARE RECOVERY (PHOTO STRESS)	BEI
709		FREQ - 3/WK	
710	1	VISUAL - DARK ADAPTATION	BEI
710		FREQ - 3/WK	
713	1	VISUAL - PERIPHERAL FIELD	BEI
713		FREQ - 3/WK	
714	1	VISUAL - ACCOMMODATION RANGE	BE
714		FREQ - 3/WK	
715	1	AUDITORY - ABSOLUTE THRESHOLD	BEI
715		FREQ - 3/WK	
716	1	AUDITORY - PITCH DISCRIMINATION	BEIH
716		FREQ - 3/WK	
717	1	AUDITORY - TEMPORAL ACUITY	BEI
717		FREQ - 3/WK	
719	1	AUDITORY - SOUND LOCALIZATION	BE
719		FREQ - 3/WK	
720	1	AUDITORY - DETECTION OF MOTION	BE
720		FREQ - 3/WK	
721	1	CUTANEOUS - PRESSURE THRESHOLD	I
721		FREQ - 3/WK	
722	1	KINESTHETIC - SENSING LIMB MOVEMENT	BE
722		FREQ - 3/WK	
723	1	KINESTHETIC - SENSING LIMB POSITION	BE
723		FREQ - 3/WK	
730	1	COGNITIVE/COMPLEX PERCEPTUAL - SPEECH INTELLIGIBILITY	
730		FREQ - 3/WK	

Table III-1. Operations Model Maxi Max Payload, Contd

```
731  1 COGNITIVE/COMPLEX PERCEPTUAL - READING
731       FREQ -  3/WK

734  1 COGNITIVE/COMPLEX PERCEPTUAL - PERCEPTUAL SPEED
734       FREQ -  3/WK

735  1 COGNITIVE/COMPLEX PERCEPTUAL - TIME SHARING
735       FREQ -  3/WK

736  1 COGNITIVE/COMPLEX PERCEPTUAL - SPATIAL ORIENTATION
736       FREQ -  3/WK

737  1 COGNITIVE/COMPLEX PERCEPTUAL - SPATIAL VISUALIZATION
737       FREQ -  3/WK

740 11 COGNITIVE/CONCEPTUAL AND THINKING ABIL.-VERBAL KNOWLEDGE.
740 21            WORD FLUENCY.NUMERICAL ABILITY.CONCEPT FLUENCY.
740 31            DISCOVERY OF PRINCIPLES.GENERAL REASONING.SEEING
740 41            IMPLICATIONS AND CONSEQUENCES(FORESIGHT).LOGICAL
740 51            EVALUATION.ETC.
740       FREQ -  3/WK

750  1 COGNITIVE/MEMORY - ROTE MEMORY
750       FREQ -  3/WK

751  1 COGNITIVE/MEMORY - MEANINGFUL MEMORY
751       FREQ -  3/WK

752  1 COGNITIVE/MEMORY - MEMORY SPAN-IMMEDIATE RECALL
752       FREQ -  3/WK

758  1 FINE PSYCHOMOTOR - WRITING ABILITY
758       FREQ -  3/WK

759  1 FINE PSYCHOMOTOR - SPEAKING ABILITY
759       FREQ -  3/WK

760  1 FINE PSYCHOMOTOR - MANIPULATIVE ABILITY-ARM/HAND STEADINESS EIH
760       FREQ -  3/WK

761  1 FINE PSYCHOMOTOR - MANIPULATIVE ABILITY-WRIST/FINGER SPEED     H
761       FREQ -  3/WK

762  1 FINE PSYCHOMOTOR - MANIPULATIVE ABILITY-FINGER DEXTERITY       H
762       FREQ -  3/WK

763  1 FINE PSYCHOMOTOR - MANIPULATIVE ABILITY-MANUAL DEXTERITY    *BEH
763       FREQ -  3/WK

764  1 FINE PSYCHOMOTOR - GROSS POSITIONG ABILTY-POSITION ESTIMATN*BEH
764       FREQ -  3/WK

766  1 FINE PSYCHOMOTOR - GROSS POSITIONG ABILTY-CONTROL PREC(TRK)BEIH*
766       FREQ -  3/WK

767  1 FINE PSYCHOMOTOR - GROSS POSITIONG ABILTY-ARM MOVEMNT SPEED    H
767       FREQ -  3/WK

768  1 FINE PSYCHOMOTOR - GROSS POSITIONG ABILTY-MULTILIMB COORD. BEIH*
768       FREQ -  3/WK
```

Table III-1. Operations Model Maxi Max Payload, Contd

```
769  1 FINE PSYCHOMOTOR - GROSS POSITIONG ABILTY-POSITION REPRODCT*BEH
769       FREQ -  3/WK

770  1 FINE PSYCHOMOTOR - REACTION TIME - SIMPLE                    *EIH
770       FREQ -  3/WK

771  1 FINE PSYCHOMOTOR - REACTION TIME - COMPLEX(RESP ORIENTATN) *EIH
771       FREQ -  3/WK

776  1 GROSS PSYCHOMOTOR - MUSCLE STRENGTH-IMPULSIVE-HAND/SHLDR   *BEH
776       FREQ -  3/WK

777  1 GROSS PSYCHOMOTOR - MUSCLE  STRENGTH- SUSTAINED/REPETITIVE    H
777       FREQ -  3/WK

779  1 GROSS PSYCHOMOTOR - GROSS BODY EQUILIBRIUM                    H
779       FREQ -  3/WK

780  1 GROSS PSYCHOMOTOR - GROSS BODY COORDINATION                 EIH
780       FREQ -  3/WK

782  1 GROSS PSYCHOMOTOR - SPEED OF LIMB MOVEMENT - LEGS            H
782       FREQ -  3/WK

790  1 SLEEP BEHAVIOR - LENGTH AND DEPTH OF SLEEP
790A      FREQ -  COVERED BY F18  - MONITOR SLEEPING PATTERNS-EEG
790B      FREQ -  3/DY            - CREW RECORDS

791  1 SLEEP BEHAVIOR - ABILITY TO AWAKEN AND RESPOND TO EMERGENCY
791       FREQ -  3X15 MIN/MO

792 11 INDIVIDUAL BEHAVIOR - CLOSENESS OF INTERACTIONS(FRIENDLINESS,
792 21                       ALOOFNESS, SOPHISTICATION)
792B      FREQ -  3 WK            - CRT DISPLAYED TESTS-QUESTNNRS-KYBRD RESP
792D      FREQ -  3/WK            - INTERVIEWS BY GRND COUNSELORS FOR BEHAV ANL

793 11 INDIVIDUAL BEHAVIOR - AMOUNT OF INTERACTION(INTRO-VS EXTROVERSON
793 21                       WITHDRAWAL)
793B      FREQ -  3 WK            - CRT DISPLAYED TESTS-QUESTNNRS-KYBRD RESP
793D      FREQ -  3/WK            - INTERVIEWS BY GRND COUNSELORS FOR BEHAV ANL

794  1 INDIVIDUAL BEHAVIOR - STRENGTH OF INTERACTION (ASSERTIVENESS)
794B      FREQ -  3 WK            - CRT DISPLAYED TESTS-QUESTNNRS-KYBRD RESP
794D      FREQ -  3/WK            - INTERVIEWS BY GRND COUNSELORS FOR BEHAV ANL

795  1 INDIVIDUAL BEHAVIOR - AGGRESSION REACTION
795B      FREQ -  3 WK            - CRT DISPLAYED TESTS-QUESTNNRS-KYBRD RESP
795D      FREQ -  3/WK            - INTERVIEWS BY GRND COUNSELORS FOR BEHAV ANL

796 11 INDIVIDUAL BEHAVIOR - CONFORMITY AND/OR CONTROL REACTION (DEPEN-
796 21                       DENCY,AUTHORITARIANISM,CONFORMITY)
796B      FREQ -  3/WK            - CRT DISPLAYED TESTS-QUESTNNRS-KYBRD RESP
796D      FREQ -  3/WK            - INTERVIEWS BY GRND COUNSELORS FOR BEHAV ANL

797  1 INDIVIDUAL BEHAVIOR - FLEXIBILITY/RIGIDITY REACTION
797B      FREQ -  3/WK            - CRT DISPLAYED TESTS-QUESTNNRS-KYBRD RESP
797D      FREQ -  3/WK            - INTERVIEWS BY GRND COUNSELORS FOR BEHAV ANL

798  1 INDIVIDUAL BEHAVIOR - SELF CONTROL REACTION
798B      FREQ -  3/WK            - CRT DISPLAYED TESTS-QUESTNNRS-KYBRD RESP
798D      FREQ -  3/WK            - INTERVIEWS BY GRND COUNSELORS FOR BEHAV ANL
```

Table III-1. Operations Model Maxi Max Payload, Contd

```
799 11 INDIVIDUAL BEHAVIOR - SUBJECTIVITY/OBJECTIVITY REACTION (SELF
799 21                       CENTEREDNESS VS OBJECTIVITY)
799B       FREQ -  3/WK            - CRT DISPLAYED TESTS-QUESTNNRS-KYBRD RESP
799D       FREQ -  3/WK            - INTERVIEWS BY GRND COUNSELORS FOR BEHAV ANL

800 11 INDIVIDUAL BEHAVIOR - EMOTIONALITY,SENSITIVITY OF REACTION
800 21                       (NERVOUS TENSION,ANXIETY,EMOTIONAL MATURTY
800 31                        STRESS RESPONSITIVITY)
800B       FREQ -  3/WK            - CRT DISPLAYED TESTS-QUESTNNRS-KYBRD RESP
800D       FREQ -  3/WK            - INTERVIEWS BY GRND COUNSELORS FOR BEHAV ANL

801  1 INDIVIDUAL BEHAVIOR - DESIRED OUTPUT LEVEL(MOTIVATION,ASPIRATN)
801B       FREQ -  3/WK            - CRT DISPLAYED TESTS-QUESTNNRS-KYBRD RESP
801D       FREQ -  3/WK            - INTERVIEWS BY GRND COUNSELORS FOR BEHAV ANL

802 11 INDIVIDUAL BEHAVIOR - DESIRED OUTPUT TYPE(CONSCIENTIOUS VS EXPED
802 21                       IENT,ETC.)
802B       FREQ -  3/WK            - CRT DISPLAYED TESTS-QUESTNNRS-KYBRD RESP
802D       FREQ -  3/WK            - INTERVIEWS BY GRND COUNSELORS FOR BEHAV ANL

805  1 GROUP BEHAVIOR - GROUP COMPATIBILITY
805D       FREQ -  3/WK            - CREW MOOD

806  1 GROUP BEHAVIOR - GROUP COHESIVENESS
806D       FREQ -  3/WK            - CREW MOOD

807  1 GROUP BEHAVIOR - GROUP LEADERSHIP
807D       FREQ -  3/WK            - CREW MOOD

808  1 GROUP BEHAVIOR - GROUP SIMILARITY, PERCEIVED
808D       FREQ -  3/WK            - CREW MOOD

820 11 TASK COMPLETION TIMES (E.G. TIME TO COMPLETE A SPECIFIED MAINTEN
820 21 ANCE TASK, TO ASSEMBLE AN ANTENNA RIB, TO MOVE FROM POINT A TO B
820 31 BY A MANEUVERING UNIT, TO ALIGN AN OBJECT WITH A REMOTE MANIPULA
820 41 TOR, TO COMPLETE A PROFICIENCY ASSESSMENT TASK, ETC.)
820A       FREQ - 10 MIN/DY        - SUBJECT OR EXPERMTR-ACTUATED TIMER
820B       FREQ - COVERED BY 10 MIN/DY UNDER F820A - INTEGRAL EQUIPMT TIMERS
820C       FREQ - COVERED BY 10 MIN/DY UNDER F820A - VIDEO COVERAGE

822  1 CREW BODY POSITION MEASUREMENTS
822        FREQ - 30 MIN/DY

823  1 CREW BODY MOTION MEASUREMENTS
823B       FREQ - 30 MIN/DY        - MOTION PICTURE PHOTOGRAPHY
823C       FREQ -  5 MIN/DY        - BODY MOUNTED SENSORS

824  1 FORCES,PRESSURES AND TORQUES EXERTED ON EQUIPMENT
824        FREQ -  5 MIN/DY

825  1 EYE MOVEMENT MEASUREMENTS - OPTICAL
825        FREQ - 30 MIN/DY

830  1 FREQUENCY OF EQUIPMENT/FACILITY UTILIZATION
830A       FREQ -  5 MIN/DY        - VIDEO COVERAGE
830C       FREQ -  5 MIN/DY        - BUILT-IN EQUIPMENT TIMERS

831  1 LENGTH OF USE OF EQUIPMENT/FACILITY
831A       FREQ -  5 MIN/DY        - VIDEO COVERAGE
831C       FREQ -  5 MIN/DY        - GUILT-IN EQUIPMENT TIMERS
```

Table III-1. Operations Model Maxi Max Payload, Contd

```
 832  1 SEQUENCE OF USE OF EQUIPMENT/FACILITIES
 832       FREQ -  5 MIN/DY

 833  1 CREW SUBJECTIVE COMMENTS ON EQUIPMENT/FACILITY/PROCEDURES/SCHED.
 833A      FREQ - 12X1 MIN/DY       - SPECIFIC QUESTIONNAIRES-STRUCTURED
 833B      FREQ - 12X1 MIN/DY       - CREW LOGS-UNSTRUCTURED RESPONSE

 834  1 FACILITY TRAFFIC PATTERNS
 834       FREQ -  5 MIN/WK

 840  1 MAX MASS TRANSPORTABLE - FUNCTION OF TYPE OF MOBILITY AID. ONE
 840A      FREQ -  3X30 MIN/WK                                  -SS
 840B      FREQ -  COVERED BY THE 3X30 MIN/WK UNDER F840A -SUITED

 841  1 MAX VOLUME TRANSPORTABLE - FUNCTION OF TYPE OF MOBILITY AID. ONE
 841A      FREQ -  COVERED BY THE 3X30 MIN/WK UNDER F840A -SS
 841B      FREQ -  COVERED BY THE 3X30 MIN/WK UNDER F840A -SUITED

 842  1 MAX TRANSPORTABLE MOI ABOUT CARRYING HANDLE-FUNCT OF MOB.AID.ONE
 842A      FREQ -  COVERED BY THE 3X30 MIN/WK UNDER F840A -SS
 842B      FREQ -  COVERED BY THE 3X30 MIN/WK UNDER F840A -SUITED

 843  1 MAX MASS ALIGNABLE - FUNTION OF TYPE OF RESTRAINT. ONE
 843A      FREQ -  3X30 MIN/WK                                  -SS
 843B      FREQ -  COVERED BY THE 3X30 MIN/WK UNDER F843A -SUITED

 844  1 MAX VOLUME ALIGNABLE - FUNCTION OF TYPE OF RESTRAINT. ONE
 844A      FREQ -  COVERED BY THE 3X30 MIN/WK UNDER F843A -SS
 844B      FREQ -  COVERED BY THE 3X30 MIN/WK UNDER F843A -SUITED

 845  1 MAX ALIGNABLE MOI ABOUT CARRYING HANDLE-FUNCTION OF RESTRNT. ONE
 845A      FREQ -  COVERED BY THE 3X30 MIN/WK UNDER F843A -SS
 845B      FREQ -  COVERED BY THE 3X30 MIN/WK UNDER F843A -SUITED

 846  1 REMOTE MANIPULATION
 846       FREQ -  3X1 HR/WK

AUTOMATIC
.........

 17 11 MONITOR ECG (FOR BIORESEARCH - ECG SIGNAL MGMT FROM CAGE TO CAGE
 17 21  MOD TO DATA MGMT.)
 17E       FREQ -  AS REQ'D - A-D CONVERTER AT CG MOD-WIRE TO DM

 18 11 MONITOR EEG (FOR BIORESEARCH - EEG SIGNAL MGMT FROM CAGE TO CAGE
 18 21  MOD TO DATA MGMT.)
 18E       FREQ -  AS REQ'D - A-D CONVERTER AT CG MOD-WIRE TO DM

 19  1 MONITOR EMG-EMG SIGNAL MGMT CAGE TO CAGE MOD TO DATA MGMT
 19E       FREQ -  AS REQ'D - A-D CONVERTER AT CG MOD-WIRE TO DM

 20  1 RESPIRATORY  RATE MONITORING- DOES NOT INCLUDE RESP VOLUME
 20A       FREQ -  AS REQ'D - EXTRACT FROM RESP CO2 DATA

 22  1 TEMPERATURE MSMTS
 22A       FREQ - AS REQ'D - THERMOCOUPLES
 22B       FREQ - AS REQ'D - THERMISTERS

 23  1 NUTRIENT CONSUMPTION- A COUNT OF THE NUMBER OF PELLETS CONSUMED
 23        FREQ - AS REQ'D
```

Table III-1. Operations Model Maxi Max Payload, Contd

```
24   1 WATER CONSUMPTION -WATER CONSUMED OR WATER DELIVERD
24A      FREQ - AS REQ'D - FLOWMTR IN MANIFOLD

49   1 PRESSURE MONITORING
49B      FREQ - C      - PRESSURE XDCR ELECTRONIC SIG

52   1 TRACE GAS ANALYSIS INORGANICS
52       FREQ -  1/HR

53   1 OXYGEN MONITORING
53B      FREQ -  1/HR - MASS SPECTROMETRY

54   1 CARBON DIOXIDE MONITORING
54       FREQ -  1/HR

55   1 NITROGEN MONITORING
55A      FREQ - 30 MIN/DY - GAS CHROMATOGRAPHY
55B      FREQ -  2/DY - MASS SPECTROMETRY

56   1 CARBON MONOXIDE MONITORING
56B      FREQ - 30 MIN/DY - GAS CHROMATOGRAPHY
56C      FREQ -  2/DY - MASS SPECTROMETRY

57   1 WATER VAPOR MONITORING
57A      FREQ -  1/HR - MASS SPECTROMETRY
57D      FREQ -  2/DY - DEW POINT SYS

58   1 AMMONIA MONITORING
58A      FREQ -  1/HR - INFRARED SPECTROPHOTOMETRY
58C      FREQ -  2/DY - MASS SPECTROMETRY

59   1 ATMOSPHERIC ETHYLENE MONITORING  SENS TO SOPPB
59       FREQ - 30 MIN/DY

61   1 VIBRATION MONITORING
61       FREQ - C

62   1 ACCELERATION MONITORING 10-5 TO 1G  0-100HZ
62       FREQ - C

64   1 NOISE MONITORING
64       FREQ - C

65   1 PLANT ACTIVITY-MSUR GROWTH AND MOVEMENT OF PLANTS
65A      FREQ -  1/HR FOR EA PLANT CM - TIME LAPSE VIDEO-SHORT STORAGE
65B      FREQ -  1/HR FOR EA PLANT CM - TIME LAPSE PHOTOGRAPHY
65D      FREQ - AS REQ'D - MAKE/BREAK INCREMENTAL MOTOR

66   1 ANIMAL ACTIVITY- MSUR ANIMAL ACTIVITY IN STD AND MMB CAGES
66A      FREQ - C - VIDEO-TIME LAPSE
66C      FREQ - C - ACTIVITY WHEEL MONITORING

70   1 AIR MOVEMENT
70       FREQ - C

71   1 LIGHT MONITORING-ON/OFF AND INTENSITY -ASSUME NO FREQ DATA REQ
71       FREQ - C

112  1 OXYGEN MSMTS MMB
112      FREQ - C
```

Table III-1. Operations Model Maxi Max Payload, Contd

```
113  1 CARBON DIOXIDE MSMTS MMB
113       FREQ - C

115  1 ELECTOMAGNETIC ASSAY
115       FREQ - OPERATING 1/10 OF THE TIME

165  1 EVENT MONITORING
165A      FREQ - AS REQ'D     - COMPUTER FUNCTION-MSUR V/A
165B      FREQ - AS REQ'D     - SPECIFIC SENSORS

169  1 TELEVISION MONITORING ROUTINE AND FOR DATA B/W HIGH RESOLUTION
169       FREQ - C

218  1 DEEP BODY TEMPERATURE-  IMPLANTABLE SENSOR
218       FREQ - AS REQ'D

792 11 INDIVIDUAL BEHAVIOR - CLOSENESS OF INTERACTIONS(FRIENDLINESS,
792 21                       ALOOFNESS, SOPHISTICATION)
792A      FREQ -  6/DY            - PERIODIC MONITRG OF VERBAL AND PHYSICL RESP

793 11 INDIVIDUAL BEHAVIOR - AMOUNT OF INTERACTION(INTRO-VS EXTROVERSON
793 21                       WITHDRAWAL)
793A      FREQ -  6/DY            - PERIODIC MONITRG OF VERBAL AND PHYSICL RESP

794  1 INDIVIDUAL BEHAVIOR - STRENGTH OF INTERACTION (ASSERTIVENESS)
794A      FREQ -  6/DY            - PERIODIC MONITRG OF VERBAL AND PHYSICL RESP

795  1 INDIVIDUAL BEHAVIOR - AGGRESSION REACTION
795A      FREQ -  6/DY            - PERIODIC MONITRG OF VERBAL AND PHYSICL RESP

796 11 INDIVIDUAL BEHAVIOR - CONFORMITY AND/OR CONTROL REACTION (DEPEN-
796 21                       DENCY,AUTHORITARIANISM,CONFORMITY)
796A      FREQ -  6/DY            - PERIODIC MONITRG OF VERBAL AND PHYSICL RESP

797  1 INDIVIDUAL BEHAVIOR - FLEXIBILITY/RIGIDITY REACTION
797A      FREQ -  6/DY            - PERIODIC MONITRG OF VERBAL AND PHYSICL RESP

798  1 INDIVIDUAL BEHAVIOR - SELF CONTROL REACTION
798A      FREQ -  6/DY            - PERIODIC MONITRG OF VERBAL AND PHYSICL RESP

799 11 INDIVIDUAL BEHAVIOR - SUBJECTIVITY/OBJECTIVITY REACTION (SELF
799 21                       CENTEREDNESS VS OBJECTIVITY)
799A      FREQ -  6/DY            - PERIODIC MONITRG OF VERBAL AND PHYSICL RESP

800 11 INDIVIDUAL BEHAVIOR - EMOTIONALITY,SENSITIVITY OF REACTION
800 21                       (NERVOUS TENSION,ANXIETY,EMOTIONAL MATURTY
800 31                        STRESS RESPONSITIVITY)
800A      FREQ -  6/DY            - PERIODIC MONITRG OF VERBAL AND PHYSICL RESP

801  1 INDIVIDUAL BEHAVIOR - DESIRED OUTPUT LEVEL(MOTIVATION,ASPIRATN)
801A      FREQ -  6/DY            - PERIODIC MONITRG OF VERBAL AND PHYSICL RESP

802 11 INDIVIDUAL BEHAVIOR - DESIRED OUTPUT TYPE(CONSCIENTIOUS VS EXPED
802 21                       IENT,ETC.)
802A      FREQ -  6/DY            - PERIODIC MONITRG OF VERBAL AND PHYSICL RESP

805  1 GROUP BEHAVIOR - GROUP COMPATIBILITY
805A      FREQ -  6/DY            - CREW PRODUCTIVITY MEASUREMENTS
805B      FREQ -  6/DY            - VERBAL INTERACTION MEASUREMENTS
805C      FREQ -  6/DY            - PHYSICAL INTERACTION
```

Table III-1. Operations Model Maxi Max Payload, Contd

```
806  1 GROUP BEHAVIOR - GROUP COHESIVENESS
806A      FREQ -  6/DY            - CREW PRODUCTIVITY MEASUREMENTS
806B      FREQ -  6/DY            - VERBAL INTERACTION MEASUREMENTS
806C      FREQ -  6/DY            - PHYSICAL INTERACTION

807  1 GROUP BEHAVIOR - GROUP LEADERSHIP
807A      FREQ -  6/DY            - CREW PRODUCTIVITY MEASUREMENTS
807B      FREQ -  6/DY            - VERBAL INTERACTION MEASUREMENTS
807C      FREQ -  6/DY            - PHYSICAL INTERACTION

808  1 GROUP BEHAVIOR - GROUP SIMILARITY, PERCEIVED
808A      FREQ -  6/DY            - CREW PRODUCTIVITY MEASUREMENTS
808B      FREQ -  6/DY            - VERBAL INTERACTION MEASUREMENTS
808C      FREQ -  6/DY            - PHYSICAL INTERACTION


                    2 SUPPORT OPERATIONS
                    ....................

MANUAL AND SEMIAUTOMATIC
........................

  1  1 ORGANISM RECVNG - SHIPPING ORGS IN CAGE VS SHIPPING CONTAINR, IF
  1       FREQ - 30/90 DYS

  2  1 MATERIAL RECVNG- SAME TECHNIQUE AND TRADEOFF AS FUNC NO.1
  2A      FREQ - 30/90 DYS - MATERIALS MOVED IN LFB
  2B      FREQ - 30/90 DYS - OTHER

 14  1 BIOELECTIC XDCR INSTALLATION AND SETUP- BEWARE EMI-
 14A      FREQ -  2/DY      - CRT CHECK MANUAL CALIB
 14B      FREQ - 15/WK      - CRT CHECK/PRECALIB COMPTR CAL

 15  1 CAMERA SETUP
 15       FREQ - 30/90 DYS(F)
 15       FREQ -  1/DY(BLH)

 16  1 SETUP CAMERA OPTICAL COMMUTATION-ORGANISM TO ORGANISM
 16       FREQ - 30/90 DYS

 31  1 BIOSAMPLING-OBTAINING BLOOD WHOLE ORGANSM LEAVES ETC FOR ANALYS,
 31       FREQ - 13/DY

 33  1 BLOOD PREPARATION-SYRINGE-TUBE/CAPILLARY WITH NAF EDTA ETC
 33       FREQ - 13/DY

 50  1 GAS SAMPLING- OBTAIN GAS FROM SITE XFER TO INSTMT
 50A             2/DY - MANUAL SYRINGE SAMPLES

 75  1 CREW GUIDANCE - PROVIDE DESIRED INFORMATION TO CREW ON DEMAND
 75       FREQ - 60 MIN/DY

 88  1 BACTERIAL SMEAR STAINING
 88       FREQ - 50/WK

 89  1 HISTOLOGICAL SECTIONING-WAX AND PLASTIC EMPEDMENT
 89       FREQ -  5/WK
```

Table III-1. Operations Model Maxi Max Payload, Contd

```
 90  1 HISTOLOGICAL STAINING
 90        FREQ -  5/WK

 95  1 RADIO ISOTOPE METHODOLOGY-PREPARATION AND MGMT
 95        FREQ - 15 MIN/2 WKS

 96  1 RADIOCHEM WASTE MGMT- RADIOCHEMS,ORGNSMS,AND PARTS
 96        FREQ - 15 MIN/2 WKS

 97  1 EXPERIMENT WASTE MGMT
 97        FREQ - 30 MIN/DY

105  1 ORGANISM OR SAMPLE PRESVN WITH GAS OR LIQUID CHEMICALS
105        FREQ -  4/DY

106  1 ORGANISM/SAMPLE PRES THERMAL
106        FREQ -  8/DY

107  1 ORGANISM/SAMPLE PRESVN LYOPHIL
107        FREQ -  8/DY

124  1 CREW/ORGANISM ISOLATION- REQMT TBD
124        FREQ -  5/DY (OTHER USAGE COVERED UNDER OTHER FUNCTIONS

125  1 CREW/CHEMICAL ISOLATION
125A       FREQ -  3/DY - LFB
125B       FREQ -  2/DY - GLOVE BOX, STD

126  1 CREW RADIATION ISOLATION
126        FREQ -  4 HRS/2 WKS

127  1 CREW MOBILITY/TRANSFER - CREW ACCESS TO ANY LAB AREA, WALLS, ETC
127        FREQ -  4 PERCENT OF EACH CREWMAN'S TIME

128  1 MATERIALS TRANSFER - MOVE CARGO,TOOLS,SPECIMEN IN/OUT AROUND LAB
128        FREQ -  6 PERCENT OF EACH CREWMAN'S TIME

142  1 MICROBIOLOGICAL SAMPLING, AIR, SURFACES AND LARGE ORGANISMS
142A       FREQ -  1/DY - AIR SAMPLING
142B       FREQ -  3/DY - SURFACE AND WOUND SAMPLING

143  1 PLANT HOMOGENATION
143        FREQ -  8/WK

144  1 EXPERIMENT STATUS MONITORING - CREW OBSERVATION
144        FREQ - 10/TWICE DAILY (EXPERIMENTS)

145  1 CENTRIFUGATION
145        FREQ -  3 HRS/WK

148  1 THERMAL CONTROL OF CHEMICAL PREPARATIONS-WATER BATH SUBSTITUTE
148        FREQ -  5 MIN/DY

163  1 RADIATION EXPOSURE
163        FREQ -  4 HRS/2 WKS

167  1 ANAESTHESIOLOGY-VERTEBRATES
167        FREQ -  5/WK

168  1 ANAESTHESIOLOGY-INVERTEBRATES
```

Table III-1. Operations Model Maxi Max Payload, Contd

```
168        FREQ - 10/DY (BOTTLES)

184   1 CLINOSTAT ENVIRONMENT
184        FREQ -  1 HR/WK

185   1 CYTOCHEMICAL STAINING PLANTS
185        FREQ -  16X10 MIN/WK

186   1 CYTOCHEMICAL STAINING -ANIMAL. SYSTEMS - HEMATOXALIN/EOSIN
186        FREQ - 16X10 MIN/WK

201   1 CREW RESTRAINT - STABILIZE THE CREW FOR MAX SAFTY AND EFFICIENCY
201        FREQ -  1 PERCENT OF EACH CREWMAN'S TIME

222   1 VERTEBRATE EXPERIMENT INITIATION
222        FREQ - 10/90 DYS

223   1 PLANT EXPERIMENT INITIATION
223        FREQ -  5/90 DYS

224   1 INVERTEBRATE EXPERIMENT INITIATION
224        FREQ -  5/90 DYS

225   1 CELLS AND TISSURE EXPERIMENT SETUP.
225        FREQ -  5/90 DYS

300   1 VOMITUS COLLECTION
300        FREQ -  NON-SCHEDULED

301   1 VOMITUS PRESERVATION AND STORAGE
301        FREQ -  NON-SCHEDULED

302   1 SWEAT SAMPLE COLLECTION
302        FREQ -  6-WK

303   1 SWEAT PRESERVATION AND STORAGE
303        FREQ -  6-WK

305   1 SPACE SUIT SUPPLY AND CONTROL FOR EXPERIMENTAL SETUPS
305        FREQ -  1/HR

310   1 IN FLIGHT EXERCISE  (ERGOMETER OUTPUT)
310        FREQ -  7/WK

311   1 BODY RESTRAINT/MOTION DEVICE
311        FREQ -  5 MIN/WK

356   1 SUBJECT INSTRUMENTATION AND CLEANUP
356        FREQ -  30 MIN/DY

368   1 STOOL PRESERVATION
368        FREQ -  6/WK

369   1 URINE PRESERVATION
369        FREQ -  6/WK

507   1 LIQUID TRANSFER
507A       FREQ -  5/DY      - SYRINGE TRANSFER
507C       FREQ -  5/DY      - COLLAPSIBLE BLADDER TRANSFER

516   1 ATMOSPHERIC GAS ISOLATION
```

Table III-1. Operations Model Maxi Max Payload, Contd

```
516        FREQ -  1/WK

520   1 PRESSURE SUIT DONNING AND DOFFING (EXPERIMENTAL)
520        FREQ -  6/2 WKS

521   1 PRESSURE SUIT VENTILATION AND COOLING (EXPERIMENTAL)
521A       FREQ -  3/2 WKS - UMBILICAL
521B       FREQ -  3/2 WKS - PLSS (PORTABLE LIFE SUPPORT SYS)

523   1 INGRESS/EGRESS (LABORATORY TO EVA)
523        FREQ -  1/WK

524   1 EVA MAINTENANCE TASK SIMULATION
524        FREQ -  1/2 WKS

AUTOMATIC
*********

 10   1 HOLDING PRIMATES MMB -MEASURES BASIC METABOLISM AT WORK/REST
 10        FREQ - AS REQ'D

 11   1 HOLDING RAT AND RAT SIZE ANIMALS FOR METABOLIC MSMTS
 11        FREQ - AS REQ'D

 12   1 HOLDING MOUSE MMB-SAME AS FOR RAT
 12        FREQ - AS REQ'D

 13   1 HOLDING CAGE MMB-RABBITS/MARMOTS ETC
 13        FREQ - AS REQ'D

 43   1 DIGITAL RECORDS-RECORDING OF INSTRUMENT DATA
 43        FREQ - AS REQ'D

 44   1 ANALOG RECORDS- RECORDING OF INST DATA
 44        FREQ - AS REQ'D

 50   1 GAS SAMPLING- OBTAIN GAS FROM SITE XFER TO INSTMT
 50B       FREQ - C      - MICROMANIFOLD SYSTEM

 68   1 ORGANISM IDENTIFICATION FILM
 68        FREQ - AS REQ'D

 72   1 ORGANISM IDENTIFICATION VIDEO RECORDS
 72        FREQ - AS REQ'D

 73   1 DATA STORAGE
 73A       FREQ - AS REQ'D - COMPUTER-MAG TAPE OR DISC
 73B       FREQ - AS REQ'D - COMPUTER-MEMORY CORE

 76   1 EXPERIMENT MANAGEMENT SYSTEM
 76        FREQ - AS REQ'D

 98   1 DISTILLED/STERILE WATER PREPARATION
 98        FREQ - C

195   1 ARTIFICIAL  GRAVITY -APPROX 50 PERCENT OF HOLDING CAPACITY
195A      FREQ - C          - CENTRIFUGE,MANNED DYNAMIC(BC)
195F      FREQ - C          - CENTRIFUGE,MANNED DYNAMIC(HC)

508   1 VACUUM SUPPLY
508       FREQ - AS REQ'D
```

Table III-1. Operations Model Maxi Max Payload, Contd

```
                    3 SPECIMEN MAINTENANCE
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MANUAL AND SEMIAUTOMATIC
••••••••••••••••••••••••

   3  1 VERTEBRATE FEEDING- SOLID PELLETS ARE SUPPLIED ADLIB OR REGULATD
   3A       FREQ -259/WK      - PELLETS ATTACHED TO BELT
   3C       FREQ -128/WK      - LIQUID DIET SUPPLY
   3E       FREQ -131/WK      - EXTRUDED PASTE FEEDER

   8  1 FECES MGMT-CAGE TO DISPOSAL   LIQUID TO SOLID CONSISTANCY
   8        FREQ -518/WK

  32  1 SPECIMEN STATUS OBSERVATION-PERIODIC LOOK AT ORGANISMS IN CAGES
  32        FREQ -102/DY

  79  1 ORGANISM SUBCULTURE-SUBSTRATE PREPARATION
  79        FREQ -  2/WK (BATCHES)

  80  1 ORGANISM SUBCULTURE-PLANTS
  80        FREQ -  5/DY

  81  1 MEDIA PREPARATION-CELLS AND TISSUE
  81        FREQ - 60 MIN/WK

  84  1 ORGANISM SUBCULTURING-CELLS AND TISSUE
  84        FREQ - 32/DY

 100  1 STERILIZN OF MEDIA  -NOT REQD IF PREPKGD
 100A      FREQ -  3/WK - AUTOCLAVE
 100C      FREQ -  3/WK - FILTRATION

 196  1 PRIMATE CAGE PREPARATION- INSTALL INSERTS,FEEDERS,EXPMT EQUIP---
 196       FREQ -  2 HRS/CAGE WITH 2 CAGES/90 DYS

 197  1 VERTEBRATE CAGE PREPARATION-SETUP CAGES AND HOLDING UNIT
 197       FREQ - 15 MIN/CM WITH 18 CM/90 DAYS

 198  1 PLANT HOLDING UNIT PREPARATION-INSTALL LITES,WATER,EXPT EQUIP---
 198       FREQ - 15 MIN/CM WITH  5 CM/90 DAYS

 199  1  INVERTEBRATE CAGE AND HOLDING UNIT SETUP
 199       FREQ - 15 MIN/CM WITH  2 CM/90 DAYS

 200  1 CELLS AND TISSUE HOLDING UNIT SETUP/PREPARATION
 200       FREQ - 15 MIN/CM WITH  3 CM/90 DAYS

AUTOMATIC
•••••••••

   4  1 VERTEBRATE WATERING- REQ DRIPLESS ANIMAL ACTUATED DISPENSOR TIPS
   4        FREQ - AS REQ'D

   5  1 URINE MGMT AT CAGE- URINE MUST BE REMOVED QUICKLY (MINUTES)
   5 21   AIR FLOW THRU CAGE MOVES URINE TO COLLECTION PAD, URINE MUST
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Table III-1. Operations Model Maxi Max Payload, Contd

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   5        FREQ - AS REQ'D

   6  1 URINE MGMT FROM CAGE COLLECTOR TO STORAGE OR DISPOSAL
   6        FREQ - AS REQ'D

   7  1 FECES MGMT AT CAGE -FECES MUST BE MOVED FROM ANIMAL AND COLLECTD
   7        FREQ - AS REQ'D

 102  1 STERILIZN OF ATM GASES
 102        FREQ - C

 129  1 HOLDING-PRIMATES- LARGE MACAQUE TO CHIMPANZEES
 129A       FREQ - C      - MODULE PRIMATE
 129C       FREQ - C       - CYLINDERS

 130  1 HOLDNG-MICE AND MICE SIZE ANIMALS
 130        FREQ - C

 131  1 HOLDING,RATS QUAIL ETC
 131        FREQ - C

 132  1 HOUSING-PLANT SEEDLINGS
 132        FREQ - C

 133  1 HOLDING UNIT PLANTS
 133        FREQ - C

 134  1 HOLDING-RABBITS CATS MARMOTS ETC
 134        FREQ - C

 135  1 HOLDING-CELLS AND TISSUE
 135        FREQ - C

 136  1 HOLDING INVERTEBRATES
 136        FREQ - C

 137  1 HOLDING-COLONY MICE HAMSTERS ETC
 137        FREQ - C

 138  1 HOLDING COLONY RATS
 138        FREQ - C

 139  1 HOLDING COLONY MARMOTS/RABBITS
 139        FREQ - C


                    4 EQUIPMENT MAINTENANCE
                    ......................

MANUAL AND SEMIAUTOMATIC
........................

  82 11 WORK BENCH CLEANUP - DEACTIVAT EQUIP, RECAGE OR DISPOSE OF SPEC-
  82 21  IMEN(S), CLEANUP AND STOW EQUIP, DISPOSE OF WASTE, CLEAN BENCH
  82 31  SURFACE, STOW AND/OR DISPOSE OF CLEANING MATERIAL
  82       FREQ -  7/DY (BENCHES)

  83  1 WORKBENCH STERILIZATION
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Table III-1. Operations Model Maxi Max Payload, Contd

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83A       FREQ -  1/DY (BENCHES) - ALCOHOL OR QUAD AMMONIA WASH
83C       FREQ - 10/DY (LINERS) - WORK BENCH AUTOCLAVABLE LINERS

99  1 STERILIZATION OF TOOL/EQUIP
99A       FREQ -  1/2 DYS(ALL ITEMS AT ONCE) - ETO OR PRO GAS
99D       FREQ - 10/2 DYS(INDIVIDUALLY)- ALCHOL OR QUAD AMMON (BAC)

101  1 STERILZN OF HOLDNG UNITS
101       FREQ - ACCOUNTED FOR BY F2A

103  1 ORGANSM HOLDING UNIT CLEANUP
103A      FREQ - 90/WK (CM) - SCRAPERS/BRUSHES ON VAC TOOL
103C      FREQ - 12/WK (CM) - REMOVE CAGES TO AUTOWASHER

104  1 HOLDING UNIT MANIFOLD CLEANUP
104       FREQ -  1/90 DYS

312  1 ELECTRONIC EQUIPMENT CALIBRATION
312A      FREQ - 30 MIN/WK
312B      FREQ - 30 MIN/WK

313  1 ATMOSPHERIC MONITOR CALIBRATION
313       FREQ - 30 MIN/WK

314  1 BIOCHEMANALYTICAL EQUIPMENT CALIBRATION
314       FREQ - 60 MIN/WK

358  1 BIOMEDICAL EQUIPMENT CLEANUP/DISPOSAL
358       FREQ - 15 MIN/DY

513  1 ELECTRICAL MAINTENANCE
513       FREQ - 15 MIN/WK

514  1 MECHANICAL MAINTENANCE
514       FREQ - 15 MIN/WK

517  1 CLEAN-UP, LIQUID AND SOLID
517       FREQ -  1/DY

518  1 TRASH DISPOSAL
518       FREQ -  1/DY

950  1 ROUTINE EQUIPMENT MAINTENANCE
950       FREQ - 30 MIN/DY
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III.2 EQUIPMENT OPERATIONS ANALYSIS

The operation of the equipment in the Life Sciences payload was analyzed to determine average power consumption, equipment usage rates, the related workspace volume required, and to verify the initial estimates of the number of each equipment item required. The primary documentation of these analyses is presented in Table III-2, Equipment Operations Analysis. The table contains the reference number of each equipment item tabulated in the left-hand column, followed by the name of the item, the equipment unit to which it belongs, and its weight, rated power, and volume. Beneath the name of each piece of equipment are the functions that use the equipment identified by reference number and title. Directly opposite each using function are the number of that equipment item required for the function, an estimate of the length of time that the equipment is "on" (using power), and the power consumption as a 24 hour average. The number required column has been summed across the using functions to give the total number required of each piece of equipment. This number corresponds to the total appearing in the equipment inventories.

Table III-2. Equipment Operations Analysis
Maxi Max Payload

REF. NO.	EQUIPMENT ITEM (EU)/INVENTORY WT., PWR., VOL.	NO. REQ.	CREW[1] USE TIME, MIN/X	EQUIP[2] "ON" TIME, MIN/X	AVE[3] PWR, WATTS
001	Acceleromtr (activity) (3)/.2, 0, .036				
	61A Vibration monitoring	10	a	0	0
	62A Acceleration monitoring	10	a	0	0
	823C Crew body motion measmts. - body mntd.	6	5/dy	0	0
		39	5/dy[4]		0
					0
001A	Acceleromtr coupler (3)/2, 10, .001				
	61A Vibration monitoring	10	a	c	100
	62A Acceleration monitoring	10	a	c	100
	823C Crew body motion measmts. - body mntd.	6	5/dy	5/dy	0
		45	5/dy		200
003B	Air lock, EVA (11)/ *				
	523A Ingress/egress (Lab to EVA)	1	30/wk	*	*
		1	5/dy		
003C	Adapters, TV-Microscope (1)/.4, 0, .1				
	170A TV monitoring ad hoc - color	1	15/dy	0	0
		1	15/dy		0
006	Air partcl smpl colect (61)/6, 0, .03				
	141A Airparticulate sampling and analysis	1	10/dy	0	0
	142A Microbio samplg-air	1	5/dy	0	0
		1	15/dy		0
007	Autoanalyzer, multiple (5)/100, 150, 3.0				
	155A Urinary phosphates	1	180/wk	180/wk	3
	156C Urine creatinine and creatine	1	22/wk	22/wk	0
	174C Enzyme assay	1	43/mo	43/wk	0
	177D Protein assay	1	9/wk	9/wk	0
	336A Plasma glucose	1	6/wk	6/wk	0
	337A " phosphate	1	6/wk	6/wk	0
	338A " alkaline phosphatase	1	6/wk	6/wk	0
	339A " bilirubin	1	6/wk	6/wk	0
	362B Urine serotonin and aldosterone	1	42/wk	42/wk	1
		1	48/dy		4
008	Anlzr, amino acid (5)/88, 700, 3.9				
	175A Amino acids assay - in space	1	15/mo	15/mo	0
		1	1/dy		0
008A	Anlzr, atom ads sptrph (5)/80, 110, 4				
	34B Blood electrolytes - atomic absorption	1	40/wk	40/wk	0
		1	7/dy		0
008B	Anlzr, carbohydrate (5)/75, 100, 2				
	69B Carbohydrate analysis	1	50/wk	50/wk	1
		1	8/dy		1
010	Anlzr, genl, IR specph (5)/100, 250, 4.6				
	58A Ammonia monitoring - infrared spec	1	a	5/hr	21
		1	a		21
011	Anlzr, genl, spectrpho (5)/300, 450, 15				
	42A Hemoglobin	1	14/wk	14/wk	1
	51C Trace gas analysis hydrocarbons - IR spec.	1	10/dy	10/dy	3
	501C Analysis of gas mixtures - IR absorptn	1	4/dy	4/dy	1
ad		1	16/dy		5
012	Anlzrs, specif ion (5)/10, 10, .5				
	504A Water analysis - PH measurement	1	5/4 hr	5/4 hr	0
		1	10/dy		0
012A	Anlzr, conductivity (5)/3, 3, .1				
	503A Water analysis - conductivity measurement	1	5/4 hr	5/4 hr	0
		1	10/dy		0
013	Anlzr, urine, auto (5)/20, 50, 1				
	149A Urine analysis - in space	1	20/wk	60/wk	0
		1	3/dy		0
014	Anesthetzr (invert handling) (4)/12, 0, .4				
ad	78A Invertebrate counting and sorting	1	30/wk	0	0
		1	5/dy		0

1 Time one or more crewmen are using equip.
2 "On" time is defined as power consuming time except for selected items (e.g., refrigerators) which are considered to be on continuously with appropriate averaging of the power.
3 Ave pwr on a 24 hr day, 7 day per wk base.
4 Average time per crew day
* Experiment or payload/layout specific.
a automatic
c continuous
ar as required
ad see addendum

Table III-2. Equipment Operations Anaylsis, Contd

Maxi Max Payload

REF. NO.	EQUIPMENT ITEM (EU)/INVENTORY WT., PWR., VOL.	NO. REQ.	CREW USE TIME, MIN/X	EQUIP "ON" TIME, MIN/X	AVE PWR, WATTS
014B	Antennas, assorted (2)/*	4	a	*	*
	115A Electromagnetic assay	4	a		
015	Anthropometric grid (93)/4, 0, 0.1				
	65B Plant activity - time lapse photography	7pk	a	0	0
	822B Crew body position measurements - cine	1	a	0	0
	823B Crew body motion measurements - cine	1	a	0	0
		7pk	a		0
		1	a		0
015A	Atmos sampling - mnfd sys (5)/*	10	a	*	*
	50B Gas sampling - micromanifold sys	10	a		
015D	Audio stereo headset (91)/1.5.0,0.2				
	715A Auditory-absolute threshold	1	6/wk	0	0
	716A Auditory-pitch discrimination	1	7/wk	0	0
	717A Auditory-temporal acuity	1	7/wk	0	0
	719A Auditory-sound localization	1	7/wk	0	0
	720A Auditory-detection of motion	1	7/wk	0	0
	730A Cognitive/complex perceptual-speech intell.	1	15/wk	0	0
		2	8/dy		0
ad					
016B	Audiometer (5)/10,25,0.15				
	715A Auditory-absolute threshold	1	6/wk	6/wk	0
	716A Auditory-pitch discrimination	1	7/wk	7/wk	0
	717A Auditory-temporal acuity	1	7/wk	7/wk	0
	719A Auditory-sound localization	1	7/wk	7/wk	0
	720A Auditory-detection of motion	1	7/wk	7/wk	0
ad		2	7/dy		0
016D	Badges-rad, std. film (25)/0.1,0,.001				
	63A Radiation monitoring-film sensors	110	110/wk	0	0
		532	18/dy		0
016E	Bags-plastic, permeabl (6)/0.1,0,.001				
	97A Experiment waste mgmt.	2000	30/dy	0	0
		2000	30/dy		0
016F	Coupler ballistocardiogram (30)/0.2,1, .036				
	326A Ballistocardiography - discrete unit	1	40/wk	40/wk	0
	326B Ballistocardiography-backpack	1	40/wk	40/wk	0
		1	13/dy		0
017	Bench, elct/mech (6)/100, 200, 20				
	14A Bioelectric XCR installation - manual calib.	1	10/dy	10/dy	1
	14B Bioelectric XCR installation - precalib.	1	25/wk	25/wk	1
	196B Primate cage preparation - in space	1	240/90 dy	240/90dy	0
		1	17/dy		2
018	Bench, lam flo (4)/175, 100, 23				
	1A Organism receiving	1	97/90 dy	97/90dy	0
	2A Material receiving	1	97/90 dy	97/90 dy	0
	6A Urine mgmt - cage to disposal	1	(see 8B below)		
	8B Feces mgmt - cage to disposal	1	537/wk	537/wk	5
	31B Biosampling	1	65/dy	65/dy	5
	101C Sterilizn of holding units	1	(see 2A above)		
	124A Crew/organism isolation	1	50/dy	10/dy	1
	125A Crew/chemical isolation-LFB	1	30/dy	10/dy	1
	195A Artificial gravity-manned centrfg.	1	(see other functions)		
	197A Vertebrate cage preparation	1	(see 1A above)		
	198A Plant holding unit preparation	1	(see 1A above)		
	199A Invertebrate cage-holding unit setup	1	(see 1A above)		
	200A Cells and tissue holding unit setup	1	(see 1A above)		
	222B Vertebrate experiment initiation	1	300/90 dy	300/90dy	0
	223B Plant experiment initiation	1	150/90 dy	150/90dy	0
	224B Invertebrate experiment initiation	1	150/90 dy	150/90dy	0
	225B Cells and tissue experiment setup	1	150/90 dy	150/90dy	0
	353A Culture/sensitivity-microorganism growth cap.	1	20/3 wk	20/3 wk	0
		2	248/dy		12
018A	Bench liners, LFB (4)/10, 0, 2				
	83C Workbench sterilization-liners	10	50/dy	0	0
		12	50/dy		0

Table III-2. Equipment Operations Analysis, Contd
Maxi Max Payload

REF. NO.	EQUIPMENT ITEM (EU)/ INVENTORY WT., PWR., VOL.	NO. REQ.	CREW USE TIME, MIN/X	EQUIP "ON" TIME, MIN/X	AVE PWR, WATTS
018B	Bench insert LFB, radioc (4)/50, 0, 2	2	15/2 wk	0	0
	95C Radio isotope methodology - prep and mgmt.	2	1/dy		0
018C	Bicycle ergometer (30)/150, 48, 12				
	310A Bicycle ergometry	1	538/wk	538/wk	3
		1	90/dy		3
018D	Custom bite boards (12)/0.5, 0, .001				
	307A Spatial localization	3	150/wk	0	0
	317A Ocular counter-rolling	3	180/wk	0	0
	345A Angular acceleration threshold	3	105/wk	0	0
		12	73/dy		0
019	Bench, genl exper (5)/100, 50, 9				
	14A Bioelectric Xdcr installation - mnl cal	1	10/dy	10/dy	0
	14B Bioelectric Xdcr installation - precal	1	60/wk	60/wk	0
	78A Invertebrate counting and sorting (insects)	1	30/dy	30/dy	1
	82A Work bench cleanup	1	35/dy	35/dy	1
	91A Plant radiochemistries	1	320/2 wk	320/2 wk	1
	92A Vertebrate radiochemistries	1	320/2 wk	320/2 wk	1
	93A Invertebrate radiochemistries	1	320/2 wk	320/2 wk	1
	94A Cells and tissue reaiochemistries	1	320/2 wk	320/2 wk	1
		2	192/dy		6
019A	Biobackpack, micro (42)/0.1, 0, .05				
	17C Monitor ECG - Xmtr on orgnsm, recvr at CM	16	20/wk	0	0
	18C Monitor EEG - "	16	20/wk	0	0
	19C Monitor EMG - "	16	20/wk	0	0
		16	10/dy		0
019B	Burner, catalytic (3)/*				
	102A Sterilization of atm gases	1	a	*	*
		1	a		
019C	Botl C/T cult opt flts (61)/0.3, 0,.02				
	505A Water analysis - total solids content	10	5/dy	0	0
	506A Water analysis - bacteriolgcl assay	17	20/dy	0	0
	507C Liquid transfer - collapsible bladder	5	15/dy	0	0
		32	40/dy		0
019D	Body mass measurement (12)/25, 2, 28				
	343A Body mass measurement for man	1	12/dy	12/dy	0
		1	12/dy		0
022	Cage, colny, rat (40)/4 20 2.2				
	103C Organism holding unit cleanup-at washer	8	10/wk	0	0
	138B Holding colony rats	8	a	1/2 c	80
		8	2/dy		80
023	Cage, colny, rab (40)/21, 10, 4.5				
	137A Holding colony-mice, hamsters, etc.	5	a	1/2 c	25
	139A Holding colny-marmots/rabbits	3	a	1/2 c	15
		8	a		40
024	Cage insrt, mice (42)/0.5, 0, 0.1				
	130A Holding-mice	16	a	0	0
ad		16	a		0
025A	Colony chmbr, sealbl,lv (70)/2, 0, 0.2				
	93A Invertebrate radiochemistries	4	320/2 wk	0	0
		4	27/dy		0
025B	Colony chmbr, sealbl, ct (60)/0.5, 0, 0.1				
	94A Cells and tissue radiochemistries	4	320/2 wk	0	0
ad		4	27/dy		0
026B	Cage MMB, plnt(50)/25,0,2.73				
	91A Plant radiochemistries	32	320/2 wk	0	0
		32	27/dy		0
027	Cage, MMB, rab (40)/7, 20, 2.2				
	13A Holding cage MMB-rabbits/marmots	8	a	1/2 c	80
		8	a		80
028	Cage, MMB, rat (40)/5, 10, 0.5				
	11A Holding rat for metabolic msmts	17	a	1/2 c	85
	12A Holding mouse MMB	17	a	1/2 c	85
		34	a		170
028A	Cage monk macac (41)/250, 50, 25				
	129C Holding, primates - cylinders	4	a	1/2 c	100
ad		4	a		100

Table III-2. Equipment Operations Analysis, Contd
Maxi Max Payload

REF. NO.	EQUIPMENT ITEM (EU)/INVENTORY WT., PWR., VOL.	NO. REQ.	CREW USE TIME, MIN/X	EQUIP "ON" TIME, MIN/X	AVE PWR, WATTS
029A	Cage, primate sphere (41)/500,50,68				
	10A Holding primates MMB	1	a	1/2 c	25
	129A Holding primates	1	a	1/2 c	25
		2	a		50
030	Cage, rab/mar/g pg/chk (40)/9, 10, 1.2				
	134A Holding-rabbits, cats, marmots	60	a	1/2 c	300
	138A Holding colony-rats	6	a		30
		66	a		330
030A	Cage, rat/hamp/quail (40)/5, 5, 0.25				
	130A Holding-mice	131	a	1/2 c	327
	131A Holding-rats, quail	131	a	1/2 c	328
		262	a		655
030B	Cage, shelf, plnt seedl (51)/1, 0, 0.1				
	132A Housing - plant seedlings	8	a	0	0
		8	a		0
032	Camera, cine (1)/8, 10, 0.3				
	15A Camera setup	1	20/dy	10/dy	0
	65B Plant activity - time lapse photo	25	a	1/hr	4
	822B Crew body position measurements	3	30/dy	30/dy	1
	823B Crew body motion measurements	3	30/dy	30/dy	1
		32	80/dy		6
032A	Camera controller (1)/10 200 0.5				
	32A Specimen status observator	1	102/dy	102/dy	14
	65A Plant activity - time lapse video	1	a	1/hr	3
	66A Animal activity - time lapse video	1	a	1/dy	0
	169A Television monitoring, routine and for data, B/W	1	a	1/10 c	20
	170A Television monitoring, ad hoc, color	1	60/dy	60/dy	8
		2	162/dy		45
034	Camera still (1)/25 0, 0.1				
	15A Camera Setup	2	20/dy	0	0
		2	20/dy		0
036	Camera-iris 35mm special (31)/1.5, 0, 0.2				
	317A Ocular counter-rolling	1	180/wk	0	0
		1	30/dy		0
037	Camera, video B/W (1)/1.2, 12, 0.1				
	15A Camera setup	1	20/dy	10/dy	0
	32A Specimen status observatn	70	102/dy	1/dy	1
	65A Plant activity - time lapse video	6	a	1/hr	1
	66A Animal " " " "	70	a	1/dy	0
	169A TV monitoring, routine and for data, B/W	90	a	1/10 c	108
	780A Gross psychomtr-gross body coord.	1	16/wk	15/wk	0
	792A Individual behavior - periodic monitoring	20	a	(see 169A above)	
	793A " " " "	20	a	(see 169A above)	
	794A " " " "	20	a	(see 169A above)	
	795A " " " "	20	a	(see 169A above)	
	796A " " " "	20	a	(see 169A above)	
	797A " " " "	20	a	(see 169A above)	
	798A " " " "	20	a	(see 169A above)	
	799A " " " "	20	a	(see 169A above)	
	800A " " " "	20	a	(see 169A above)	
	801A " " " "	20	a	(see 169A above)	
	802A " " " "	20	a	(see 169A above)	
	805A Group Behavior - crew productivity	20	a	(see 169A above)	
	805C " " - physical interaction	20	a	(see 169A above)	
	806A " " - crew productivity	20	a	(see 169A above)	
	806C " " - physical interaction	20	a	(see 169A above)	
	807A " " - crew productivity	20	a	(see 169A above)	
	807C " " - physical interaction	20	a	(see 169A above)	
	808A " " - crew productivity	20	a	(see 169A above)	
	808C " " - physical interaction	20	a	(see 169A above)	
	820C Task completion times - video coverage	2	10/dy	10/dy	0
	830A Freq. of equip/facility utilization - video	20	5/wk	(see 169A above)	
	831A Length of use of equip/facil-video	20	5/wk	(see 169A above)	
	832A Sequence of use of equip/facil	20	5/wk	(see 169A above)	
	834A Facility traffic patterns	20	5/wk	(see 169A above)	
		93	138/dy		110
038	Camera, video/color (1)/65,125,1.8				
	15A Camera setup	1	20/dy	10/dy	1
	170A TV monitoring ad hoc-color	1	60/dy	60/dy	5
		1	80/dy		6

Table III-2. Equipment Operations Analysis, Contd
Maxi Max Payload

REF NO.	EQUIPMENT ITEM (EU)/INVENTORY WT., PWR., VOL.	NO. REQ.	CREW USE TIME, MIN/X	EQUIP "ON" TIME, MIN/X	AVE PWR, WATTS
041	Cntrif frig hi spd (4)/150,70,12				
	33A Blood preparation	1	32/dy	13/dy	1
	34C Blood electrolytes - pres for grnd	1	43/wk	43/wk	0
	36C Blood total protein - pres for grnd	1	23/wk	7/wk	0
	39A Thyroid function tests	1	30/wk	30/wk	0
	47C Immunoglobin assay-pres for grnd	1	7/wk	7/wk	0
	48B Antibody titration - pres for grnd	1	7/wk	7/wk	0
	173A Plant lipids	1	70/mo	70/mo	0
		1	53/dy		1
042	Cntrif micro (4)/18,25,0.47				
	48A Antibody titration-interfacial test	1	22/wk	22/wk	0
	108B Bacterial cell counting - hematocrit	1	10/wk	100/wk	0
	145A Centrifugation	1	180/wk	180/wk	0
		1	35/dy		1
042A	Centr, ultra (4)/800, 500, 30				
	145A Centrifugation	1	180/wk	180/wk	9
		1	30/dy		9
042F	Centrifuge - common use (RC)(20/*				
	195B Artifical Gravity	1		*	*
		1			
044	Chemicals (4)/50,0,1				
	34B Blood electrolytes - atomic absorption	1	28/wk	0	0
	48A Antibody titration - interfacial test	1	22/wk	0	0
	57C Atmos water monitoring - specific sensors	1	10/dy	0	0
	69B Carbohydrate analysis	1	60/wk	0	0
	82A Work bench cleanup	1	45/dy	0	0
	83A Work bench sterilization	1	10/dy	0	0
	85B Starch granule assay	1	15/wk	0	0
	89A Histological sectioning	1	50/wk	0	0
	90A Histological staining	1	13/wk	0	0
	99B Sterilization of tool/equip.	1	50/2dy	0	0
	104A Holding unit manifold cleanup	1	60/90 dy	0	0
	105A Organism or sample presvn w/chem	1	8/dy	0	0
	167A Anesthesiology, vertebrates	1	100/wk	0	0
	173A Plant lipids	1	70/mo	0	0
	180A Plant hormones - chromatography	1	80/2 wk	0	0
	185A Cytochemical staining plants	1	160/wk	0	0
	186A Cytochemical staining, animal sys	1	160/wk	0	0
		10	209/dy		0
044A	Chemicals - radioactive (4)/10,0,0.5				
	91A Plant radiochemistries	1	320/2 wk	0	0
	92A Vertebrate "	1	320/2 wk	0	0
	93A Invertebrate "	1	320/2 wk	0	0
	94A Cells and tissue "	1	320/2 wk	0	0
		2	107/dy		0
045	Chem stor cabinet (7)/50,0.6				
	82A Workbench cleanup	1	45/dy	0	0
	180A Plant hormones - chromatography	1	80/2 wk	0	0
		1	51/dy		0
048	Cleanr, vacuum (4)/30,100,2				
	8B Feces mgmt	1	537/wk	537/wk	5
	82A Workbench cleanup	1	45/dy	35/dy	2
	103A Organsm holding unit cleanup-scrapers on vac	1	450/wk	450/wk	5
	196B Primate cage prep-in space	1	240/90 dy	120/90 dy	0
		5	212/dy		12
049	Cleanr, instrumt/appar (6)/150, 500, 11.5				
	82A Workbench cleanup	1	45/dy	30/dy	10
	103C Organsm holding unit cleanup	1	65/wk	65/wk	3
	196B Primate cage preparation	1	240/90 dy	240/90 dy	0
		1	59/dy		13

Table III-2. Equipment Operations Analysis, Contd
Maxi Max Payload

REF. NO.	EQUIPMENT ITEM (EU)/INVENTORY WT., PWR., VOL.	NO. REQ.	CREW USE TIME, MIN/X	EQUIP "ON" TIME, MIN/X	AVE PWR WATTS
049A	Cleanr, hand, steril (6)/40,300,2				
	82A Workbench cleanup	1	45/dy	15/dy	3
		1	45/dy		3
050	Clinostat (51)/40, 50.4				
	184A Clinostat environment	1	60/wk	60/wk	0
		1	10/dy		0
050A	Commutator, gas manifld (5)/5, 20,0.50				
	112B Oxygen msmts MMB	1	a	c	20
	113B Carbon dioxide msmts MMB	1	a	c	20
		6	a		40
050B	Compactor (solids) (6)/40, 100,4				
	518A Trash disposal	1	2/dy	2/dy	0
		1	2/dy		0
050C	Console, behav msmts - CRT + key (91)/150,100,8				
	721A Cutaneous - pressure threshold	1	15/wk	15/wk	0
	722A Kinesthetic - sensing limb movmt	1	7/wk	6/wk	0
	723A " " " postn	1	7/wk	6/wk	0
	731A Cognitive/complex percept1 - speech intell.	1	16/wk	15/wk	0
	734A " " " percept1 spd	1	16/wk	15/wk	0
	735A " " " time sharing	1	10/wk	9/wk	0
	736A " " " spatial orient.	1	16/wk	15/wk	0
	737A " " " " visual	1	16/wk	15/wk	0
	740A " /conceptual and thinking abil.	1	30/wk	30/wk	0
	750A " /memory-rote memory	1	15/wk	15/wk	0
	751A " " - meaningful memory	1	15/wk	15/wk	0
	752A " " - immed recall	1	15/wk	15/wk	0
	759C Fine psychomtr - speaking ability	1	15/wk	15/wk	0
	792B Individual behavior - CRT displayed tests	1	17/wk	15/wk	0
	↓				
	802B	1	17/wk	15/wk	0
	805D Group behavior - crew mood - CRT tests	1	15/wk	15/wk	0
	↓				
	808D	1	15/wk	15/wk	0
		2	71/dy		3
051	Computer, digital (2)/*				
	60 + functions	1		*	*
		1			
051A	Converter, A-D (2)/0.1, 0, .001				
	17E Monitor ECG - converter at CM, wire to DM		a	0	0
	18E " EEG "		a	0	0
	19E " EMG "		a	0	0
		1000	a		0
051C	Control panl, shield room (25)/40, 0,4				
	126A Crew radiation isolation	1	240/2 wk	0	0
		1	20/dy		0
051D	Control console. expmtr (12)/100, 100.6				
	700A Visual	1	6/wk	6/wk	0
	701A "	1	6/wk	6/wk	0
	702A "	1	6/wk	6/wk	0
	703A "	1	6/wk	6/wk	0
	704A "	1	6/wk	6/wk	0
	705A "	1	6/wk	6/wk	0
	706A "	1	3/wk	3/wk	0
	707A "	1	6/wk	6/wk	0
	708A "	1	6/wk	6/wk	0
	709A "	1	6/wk	6/wk	0
	710A "	1	60/wk	60/wk	1
	713A "	1	9/wk	9/wk	0
	714A "	1	6/wk	6/wk	0
	715A Auditory	1	6/wk	6/wk	0
	716A "	1	7/wk	6/wk	0
	717A "	1	7/wk	6/wk	0
	719A "	1	7/wk	6/wk	0
	720A "	1	7/wk	6/wk	0
	730A Cognitive/complex perceptual-speech intell.	1	15/wk	15/wk	0
	760A Fine psychomtr - manipulative abil.-stead	1	15/wk	15/wk	0
	768A " " gross positioning abil.	1	11/wk	9/wk	0
	770A " " reaction time,simple	1	7/wk	6/wk	0
	771A " " " " complex	1	7/wk	6/wk	0
		2	37/dy		3

Table III-2. Equipment Operations Analysis, Contd
Maxi Max Payload

REF. NO.	EQUIPMENT ITEM (EU)/INVENTORY WT., PWR., VOL.	NO. REQ.	CREW USE TIME, MIN/X	EQUIP "ON" TIME, MIN/X	AVE PWR WATTS
052	Countr cell (5)/10,20,0.4				
	108A Bacterial cell counting - auto countrs	1	16/wk	31/wk	0
	226B Cells and tissue populatn density	1	30/dy	30/dy	0
		1	33/dy		0
053	Countr, colony (auto) (5)/10, 20,1				
	86A Bacterial colony counting	1	30/wk	30/wk	0
		1	5/dy		0
055A	Crew mobility aids (3)/*				
	Multiple functions	50		*	*
		50			
055B	Crew restraints (3)/*				
	Multiple functions	50		*	*
		50			
056	Cryo sys (4)/100,0,1.5				
	30A Gross anatomies	1	50/wk	0	0
		1	8/dy		0
058A	Data mngmt syst, remote control statn mod (2)/*				
	43A Digital records - recording of instrument data	4	a	*	*
	75A Crew guidance	4	60/dy		
		4	60/dy		
058C	Data mngmt syst, wide band and TV data control (2)/*				
	Multiple functions	1		*	*
		1			
061	Densitomtr, X-ray (1)/50, 1500, 3				
	162B X-ray diagnostic	1	25/2dy	25/2dy	13
		1	~~13~~ dy		13
062A	Developer, film (25)/30,50,1				
	63A Radiation monitoring - film sensors	1	110/wk	30/wk	0
		1	18/dy		0
063B	Display-keybrd, int, prt (2)/10,0,0.2				
	44A Analog records	7	a	0	0
	75A Crew guidance	7	60/dy	0	0
	196B Primate cage preparation	1	240/90 dy	0	0
	222B Vertebrate experiment initiation	1	600/90 dy	0	0
	223B Plant " "	1	300/90 dy	0	0
	224B Invertebrate " "	1	300/90 dy	0	0
	225B Cells and tissue experiment setup	1	300/90 dy	0	0
		7	82/dy		0
063F	Dividers, rabbit cage (42)/2,0,0.2				
	137A Holding colony, mice, hamsters	8	a	0	0
		8	a		0
063G	Deionizer for pure water (4)/15, 10, 2				
	098B Distilled/Sterile water prep	1	a	c	10
		1	a		10
064	ECG couplr (2)/0.1,1,.036				
	17B Monitor ECG - hardwire multiplex data to DM	128	9/wk	c	128
	17F Monitor ECG - electrophysiology bkpk-man	6	180/wk	180/wk	0
		134	32/dy		128
065	EEG couplr (2)/0.1,1,.036				
	18B Monitor EEG - hardwire multiplex data to DM	32	9/wk	c	32
	18F Monitor EEG - electrophysiology bkpk-man	3	90/wk	90/wk	0
	18G Monitor EEG - discrete monitoring units-man	3	20/wk	480/dy	1
	18H Monitor EEG - electrophysiology console-man	3	15/wk	15/wk	0
	790A Sleep behavior - monitor sleeping patterns	3	(see 18G above)		
		34	22/dy		33
065B-065F	to be revised				
066	EMG couplr (2)/0.1, 1, .036				
	19B Monitor EMG - hardwire multiplex data to DM	32	9/wk	c	32
	19F Monitor EMG - electrophysiology bkpk-man		90/wk	90/wk	0
		32	17/dy		32

Table III-2. Equipment Operations Analysis, Contd
Maxi Max Payload

REF. NO.	EQUIPMENT ITEM (EU)/INVENTORY WT., PWR., VOL.	NO. REQ.	CREW USE TIME, MIN/X	EQUIP "ON" TIME, MIN/X	AVE PWR WATTS
070	Electrophrsis appar (4)/20, 85, 0.9				
	36D Blood total protein - electrophoresis	1	15/wk	15/wk	0
	47B Immunoglobin assay - disc gel electroph.	1	7/wk	7/wk	0
	340A Plasma globulins	1	50/wk	30/wk	0
		1	12/dy		0
072	Exerciser, rat (42)/0.2, 0, .05				
	206A Vertebrate behavior study	1		0	0
		1			0
072B	Feces storage sys (42)/50, 0, 1				
	8B Feces mgmt - cage to disposal - LFB	8	518/wk	0	0
		8	86/dy		0
073	Feedr, liq, auto (42)/0.5, 5, .01				
	3C Vertebrate feeding - liquid diet supply	128	129/wk	30/wk	2
		128	22/dy		2
074	Feedr, pel dispnsr (40)/0.5, 5, .01				
	3A Vertebrate feeding - pellets	259	260/wk	30/wk	4
	23A Nutrient consumption	259	a	(see 3A above)	
	196B Primate cage preparation	6	30/90 dy	15/90 dy	0
		259	44/dy		4
074B	Feedr, paste (40)/0.5, 5, .01				
	3E Vertebrate feeding - paste	131	132/wk	30/wk	2
		131	22/dy		2
076B	Fiber Optics (1)/0.2, 0, .01				
	68A Organism identification film	70	a	0	0
		70	a		0
076C	Film (1)/50, 0, 1				
	65B Plant activity - time lapse photo	2	a	0	0
	162A X-ray diagnostic	2	25/2 dy	0	0
		4	13/dy		0
076D	Film table, x-rays (26)/100, 0, 10				
	162A X-ray diagnostic	1	25/2 dy	0	0
		1	13/dy		0
076E	Filters, video (1)/1.0, 0, 0.1				
	169A TV monitoring routine and for data	1	a	0	0
		1	a		0
076F	Flowmeter, water manifld (3)/0.4, 0, .05				
	24A Water consumption - flowmtr in manfld	26	a	0	0
		26	a		0
076G	Flowmeter, ultrasonic (42)/0.4, 0, .05				
	21B Cardiac output - ultrasonic flowmeter	2	40/wk	0	0
		2	7/dy		0
077	Filtr, chemcls (4)/5.0, 0, 0.5				
	508A Vacuum supply	3	a	0	0
		3	a		0
077C	Fragiligraph (4)/5.0, 0, 0.2				
	45A RBC omotic fragility	1	45/wk	0	0
		1	8/dy		0
080	Frezr, genl (4)/35, 35, 4				
	30A Gross anatomies	1	50/wk	c	35
	39A Thyroid function tests	1	30/wk	c	35
	106A Organism/sample pres thermal	1	16/dy	c	35
	149C Urine analysis - pres for grnd anal	1	17/wk	c	35
	175B Amino acids assay - pres for grnd anal.	1	30/mo	(see above)	
	177B Protein assay - pres for grnd anal.	1	30/wk	"	
	180B Plant hormones - pres for grnd anal.	1	30/2 wk	"	
	301A Vomitus preservation and storage	1	ar	"	
	303A Sweat preservation and storage	1	18/wk	"	
	314A Biochemanalytical equip.calibration	1	60/wk	"	
	368A Stool preservation	1	35/wk	"	
	369A Urine preservation	1	35/wk	"	
	371A Viral identification	1	130/2 wk	"	
	373A Fungal "	1	130/2 wk	"	
		4	87/dy		140
081	Frezr, lo-temp (4)/25, 25, 2.5				
	34C Blood electrolytes - pres for grnd anal.	1	43/wk	c	25
	36C Blood total protein " " " "	1	23/wk	(see above)	
	47C Immunoglobin assay " " " "	1	7/wk	"	
	48B Antibody titration " " " "	1	7/wk	"	
	106A Organism/sample pres thermal	1	16/dy		
		1	29/dy		25

Table III-2. Equipment Operations Analysis, Contd
Maxi Max Payload

REF. NO.	EQUIPMENT ITEM (EU)/ INVENTORY WT., PWR., VOL.	NO.REQ.	CREW USE TIME, MIN/X	EQUIP "ON" TIME, MIN/X	AVE PWR WATTS
083	Frig (4)/30,58,6				
	79A Organism subculture, substrate prep	1	190/wk	c	58
	81B Media preparation - cells and tissue	1	60/wk	(see above)	
	87A Microorganism identification	1	150/wk	"	
	106A Organism/sample pres thermal	1	16/dy	"	
	314A Biochemanalytical equip calibration	1	60/wk	"	
	342A Plasma coagulation	1	35/wk	"	
	370A Viral culturing	1	210/2 wk	"	
		1	116/dy		58
085	Gas anlzr, auto physio (5)/18,55,1.6				
	35A Blood pH, pCO2, O2	1	40/wk	40/wk	0
		1	7/dy		0
086	Gas anlzr, CO2 (5)/4.2,0,.28				
	501E Analysis of gas mixtures-ind. sensors	2	4/dy	0	0
		2	4/dy		0
089	Gas anlzr, GC (complx) (5)/105, 500,7.3				
	51A Trace gas anal. hydrocarbons - gas chromat.	1	20/dy	60/dy	21
	55A Nitrogen monitoring - gas chromat	1	a	30/dy	10
	56B Carbon monoxide monitoring - gas chromat	1	a	30/dy	10
	59A Atmos ethylene monitoring - gas chromat	1	a	30/dy	10
	173A Plant lipids	1	70/mo	70/mo	2
	180A Plant hormones - chromatography	1	80/2 wk	80/2 wk	4
	501A Analysis of gas mixtures - chromat	1	10/dy	30/dy	10
		1	39/dy		67
090	Gas anlzr, mass spec (5)/70, 100, 2				
	51B Trace gas anal. hydrocarbons - mass spec	1	10/dy	10/dy	1
	52A Trace gas anal. hydrocarbons - mass spec	1	10/dy	10/dy	1
091	Gas anlzr, mass spec (5)/7,40,0.2	2	20/dy		2
	20A Respiratory rate montring - extract from CO_2 d	1	a	c	40
	53B Oxygen monitoring - mass spec.	1	a	c	40
	54B Carbon dioxide monitoring	1	a	c	40
	55B Nitrogen " - mass spec	1	a	c	40
	56C Carbon monoxide " "	1	a	c	40
	57A Atmos water " "	1	a	c	40
	58C Ammonia " "	1	a	c	40
	112B Oxygen msmts MMB	1	a	(see above)	40
	113B Carbon dioxide msmts MMB	1	a	"	
	328A Alveolar pO2	1	6/2 wk	"	
	329A Alveolar pCO2	1	30/2 wk	"	
	501B Analysis of gas mixtures	1	4/dy	"	
		8	7/dy		320
093A	Gas supply, assorted (3)/25,0,1.0				
	51A Trace gas anal. hydrocarbons - gas chromat		60/dy	0	0
	55A Nitrogen monitoring - gas chromat		30/dy	0	0
	56B Carbon monoxide monitoring - gas chrom		30/dy	0	0
	59A Atmos ethylene "		30/dy	0	0
	97A Experiment waste mgmt		30/dy	0	0
	99A Sterilization of tool/equip - eto or progas		120/2 dy	0	0
	168A Anesthesiology - invertebrates		30/dy	0	0
	180A Plant hormones - chromatography		80/2 wk	0	0
	313B Atmos monitor calibration		30/wk	0	0
	501A Analysis of gas mixtures - chromat.		30/dy	0	0
		26	312/dy		0
095	Genrtr, signl (.01-20K) (6)/7.5,35,0.4				
	312B Electronic equipment calibration - in place	1	30/wk	30/wk	0
		1	5/dy		0
096	Glv bx (4)/65,30,9				
	30A Gross anatomies	1	50/wk	50/wk	0
	125B Crew/chemical isolation - std glv bx	1	20/dy	10/dy	0
		1	28/dy		0
097	Glv bx, rad tracr cap (4)/600,0,9.0				
	126A Crew radiation isolation	1	240/2 wk	0	0
		1	20/dy		0
097A	Hematocrt, electrnic (4)/20,100,1.5				
	41B Hematocrit msur of pkd cell vol to tot vol	1	4/wk	4/wk	0
		1	1/dy		0
097B	Harness, small wire (42)/*				
	17B Monitor ECG-hardwire multiplex data to IM	1	9/wk	*	*
	18B " EEG "	1	9/wk		
	19B " EMG "	1	9/wk		
		1	5/dy		

Table III-2. Equipment Operations Analysis, Contd
Maxi Max Payload

REF. NO.	EQUIPMENT ITEM (EU)/INVENTORY WT., PWR., VOL.	NO. REQ.	CREW USE TIME, MIN/X	EQUIP. "ON" TIME, MIN/X	AVE PWR WATTS
098A	Hold unit incbtr-cells (60)/70, 50, 6.64				
	48A Antibody titration-interfacial test in agar	1	22/wk	(see 135A below)	
	84A Organism subculturing, C & T	1	67/dy	"	
	87A Microorganism identification	1	150/wk	"	
	135A Holding - C & T	8	a	c	400
	506A Water analysis, bacteriological assay	1	20/dy	(see 135A above)	
	353A Culture/sensitivity, microorganism growth cap.	1	20/3 wk	"	
	370A Viral culturing	1	210/2 wk	"	
		8	136/dy		400
098C	Hold Unit incbtr - inverts (70)/80, 50, 7.36				
	136A Holding invertebrates	6	a	c	300
		6	a		300
100	Hold unit, MMB primate (41)/90, 70, 230				
	10A Holding Primates MMB	2	a	c	140
		2	a		140
101	Hold unit, plnt (50)/60, 10, 6.64				
	132A Housing, plant seedlings	6	a	1/2c	30
	133A Holding unit plants	12	a	1/2c	60
		18	a		90
103	Holding unit, sm verts (40)/60, 0, 6.64				
	131A Holding, rats, quail, etc.		a	0	0
	134A Holding, rabbits, cats, marmots, etc.		a	0	0
	137A Holding, colony, mice, hamsters, etc.		a	0	0
	139A Holding, colony, marmots, rabbits		a	0	0
		76	a		0
104A	Homogenizer (4)/10, 100, 1.1				
	143A Plant homogenation	1	45/wk	45/wk	0
	173A Plant lipids	1	70/mo	70/mo	0
		1	10 dy		0
104E	Coupler, impedance cardigrm (30)/0.2, 1, .01				
	321A Impedance cardiography - discrete unit		50/3 dy	50/3 dy	0
	321B Impedance cardiography - EP backpack		50/3 dy	50/3 dy	0
		4	33/dy		0
105	Kit, bench chem anal (4)/40, 0, 4				
	26A Liquid vol. msmts, micro - micropipettes	1	6/dy	0	0
	26B Liquid vol. msmts, micro - microsyringes & N.	1	8/dy	0	0
	27A Liquid vol. msmts, macro - macrosyringes	1	30/dy	0	0
	28A Mass msmts of contained liq & solids (.001-100 gm)	1	18/dy	0	0
	29A Mass msmts of contained liq & solids (10-1000 gm)	1	27/dy	0	0
	33A Blood preparation	1	32/dy	0	0
	34B Blood electrolytes - atomic absorption	1	48/wk	0	0
	34C Blood electrolytes - pres for grnd anal	1	43/wk	0	0
	36C Blood total protein - pres for grnd anal	1	23/wk	0	0
	39A Thyroid function tests	1	30/wk	0	0
	45A RBC omotic fragility	1	45/wk	0	0
	47B Immunoglobin assay - disc gel electrophor.	1	7/wk	0	0
	47C Immunoglobin assay - pres for grnd anal	1	7/wk	0	0
	48A Antibody titration - interfacial test in agar	1	22/wk	0	0
	48B Antibody titration - pres for grnd anal	1	7/wk	0	0
	50A Gas sampling - manual syringe sample	1	20/dy	0	0
	53A Oxygen monitoring - polarographic sensr	1	10/dy	0	0
	79A Organism subculture - substrate prep	1	190/wk	0	0
	80A Organism subculture - plants	1	30/dy	0	0
	177B Protein assay - pres for grnd anal	1	30/wk	0	0
	180A Plant hormones - chrometography	1	80/2 wk	0	0
	370A Viral culturing	1	210/2 wk	0	0
	372A Fungal culturing	1	130/2 wk	0	0
		1	291/dy		0
105A	Kit, behavioral msrmts I (91)/15, 0, 4				
	758B Fine psychomotor msmts, writing ability	2	15/wk	0	0
	779A Gross psychomotor msmts, gross body equilbrm	2	16/wk	0	0
	782A Gross psychomotor msmts, spd of limb movement	2	6/wk	0	0
	791A Sleep behavior msmts, response to emergency	2	45/mo	0	0
		2	8/dy		0
105B	Kit, behavioral msrmts II (91)/5.0, 0, 0.5				
	758B Fine psychomtr msmts, writing ability	2	15/wk	0	0
	833A Crew subjective comments, specific questnnrs	2	12/dy	0	0
		2	15/dy		0

Table III-2. Equipment Operations Analysis, Contd
Maxi Max Payload

REF. NO.	EQUIPMENT ITEM (EU)/INVENTORY WT., PWR., VOL.	NO. REQ.	CREW USE TIME MIN/X	EQUIP. "ON" TIME MIN/X	AVE PWR WATTS
106	Kit, hematology (4)/10, 0, 0.5				
	40A Blood morphology and cell counts	1	172/wk	0	0
	42A Hemoglobin	1	24/wk	0	0
	333A Bleeding time	1	10/2 wk	0	0
	334A Clotting time	1	15/2 wk	0	0
	342A Plasma coagulation	1	35/wk	0	0
	348A Gonad histopathology	1	95/2 wk	0	0
		1	48/dy		0
106A	Kit, clean-up (6)/5, 0, 0.2				
	517A Clean-up, liq. and solid	4	5/dy	0	0
	950A Routine equip. maintenance	4	30/dy	0	0
		4	35/dy		0
108	Kit, hist. (4)/12.5, 25, 1.5				
	84A Organism subculturing, cells and tissue	1	67/dy	0	0
	85B Starch granule assay	1	15/wk	0	0
	89A Histological sectioning	1	50/wk	0	0
	108B Bacterial cell counting - hematocrit	1	10/wk	0	0
		1	79/dy		0
109	Kit, linear meas (6)/50, 0, 3.0				
	166A Linear msmts	1	15/wk	0	0
	355A Muscle strength and size	1	93/3 wks	0	0
		1	8/dy		0
110	Kit, microbiology (4)/5, 0, 1				
	84A Organism subculturing, cells and tissue	1	67/dy	0	0
	87A Microorganism identification	1	150/wk	0	0
	88A Bacterial smear staining	1	250/wk	0	0
	108A Bacterial cell counting - auto counters	1	16/wk	0	0
	108B Bacterial cell counting - hematocrit	1	10/wk	0	0
	108C Bacterial cell counting - vital staining	1	30/mo	0	0
	142A Microbiological sampling - air	1	5/dy	0	0
	142B Microbiological sampling - surface & wound	1	15/dy	0	0
	226B Cells and tissue population density	1	30/dy	0	0
	353A Culture/sensitivity - microorganism growth cap	1	20/3 wk	0	0
	370A Viral culturing	1	210/2 wk	0	0
	372A Fungal culturing	1	130/2 wk	0	0
		1	219/dy		0
110B	Kit, org hldg/mgmt (6)/20, 0, 2				
	6A Urine mgmt from collector to disposal	1	a	0	0
		1	a		0
110C	Kit, physiology (31)/15, 0, 2				
	302A Sweat sample collection	1	20/wk	0	0
	303A Sweat preservation and storage	1	18/wk	0	0
	306A Ear canal caloric stimulation	1	105/wk	0	0
	307A Spatial localization	1	150/wk	0	0
	315A Total body water	1	60/wk	0	0
	335A Erythrocyte survival	1	285/mo	0	0
	347A Intraocular pressures	1	65/2 wk	0	0
	354A Ear canal temperature	1	30/3 wk	0	0
	355A Muscle strength and size	1	95/3 wk	0	0
	356B Subject instrumentation and cleanup	1	30/dy	0	0
	357A Gastric pressure and pH	1	75/wk	0	0
	358B Biomedical equipment cleanup/disposal	1	15/dy	0	0
		1	139/dy		0
111	Kit, plnt tools (51)/20, 0, 4				
	31B Biosampling	1	65/dy	0	0
	173A Plant lipds	1	70/mo	0	0
		1	68/dy		0
112	Kit, surgical (42)/20, 0, 1.0				
	164A Peripheral venous blood pressure	1	60/wk	0	0
	167A Anesthesiology	1	100/wk	0	0
		1	94/dy		0
113	Kit, tool, genl (6)/25, 50, 1.3				
	82A Work bench cleanup	1	45/dy	0	0
	83A Work bench sterilization	1	10/dy	0	0
	99D Sterilization of tool/equip - alcohol, etc.	1	50/2 dy	0	0
	507A Liquid transfer - syringe	1	15/dy	0	0
	513A Electrical maintenance	1	15/wk	15/wk	0
	514A Mechanical maintenance	1	15/wk	15/wk	1
	950A Routine equipment maintenance	1	30/dy	30/dy	1
		1	130/dy		1

Table III-2. Equipment Operations Analysis, Contd
Maxi Max Payload

REF. NO.	EQUIPMENT ITEM (EU)/INVENTORY WT., PWR., VOL.	NO. REQ.	CREW USE TIME MIN/X	EQUIP. "ON" TIME MIN/X	AVE PWR WATTS
113A	Kit, tool, insect manip. (51)/10, 0, 0.5				
78A	Invertebrate counting and sorting (insects)	1	30/dy	0	0
		1	30/dy		0
ad					
115	Kit, vetenry (42)/5, 0, 1				
9A	Organism mass measurements	1	25/dy	0	0
		1	25/dy		0
ad					
115D	Limb board, mtr or manual rotatn (91)/3, 5, 0.3				
722A	Kinesthetic - sensing limb movement	1	7/wk	6/wk	0
723A	Kinesthetic - sensing limb position	1	7/wk	6/wk	0
		2	2/dy		0
116	Log books for daily records (1)/1, 0, .05				
346B	Subject histories - printed forms & notebk	12	12/dy	0	0
350A	Crew metabolic records - lab notebk	12	12/dy	0	0
790B	Sleep behavior, length & depth - crew records	12	15/dy	0	0
833B	Crew subjective comments - crew logs	12	12/dy	0	0
		30	51/dy		0
117	Lower body negative press (30)/33, 0, 10.6				
304A	Lower body negative pressure	1	435/wk	0	0
		1	73 dy		0
118	Lyphilzr (space vac) (4)/10, 0, 0.8				
34C	Blood electrolytes - pres for grnd anal	1	43/wk	0	0
36C	Blood total protein - pres for grnd anal	1	23/wk	0	0
47C	Immunoglobin assay - pres for grnd anal	1	9/wk	0	0
48B	Antibody titration - pres for grnd anal	1	7/wk	0	0
107A	Organism/sample presvn lyophil	1	45/dy	0	0
175B	Amino acids assay - pres for grnd anal	1	30/mo	0	0
177B	Protein assay - pres for grnd anal	1	30/wk	0	0
180B	Plant hormones - pres for grnd anal	1	30/2 wk	0	0
371A	Viral identification	1	130/2 wk	0	0
373A	Fungal identification	1	130/2 wk	0	0
		1	89/dy		0
118A	Manifld flush sys, hldg unit (6)/10, 0, 1				
104A	Holding unit manifold cleanup	1	60/90 dy	0	0
		1	2/dy		0
118B	Manifld, O_2/CO_2 msmts (5)/*				
112B	Oxygen msmts MMB	6	a	*	*
113B	Carbon dioxide msmts MMB	6	a		
		6	a		
ad					
118I	Manifld, vacuum (80)/20, 0, 2				
508A	Vacuum supply	2	a	0	0
		2	a		0
119	Maintenance task simulator, EVA (11)/20, 5, 20				
524A	EVA maintenance task simulation	1	60/2wk	60/2wk	0
		1	5/dy		0
119A	Manipulator, remote (11)/200, 40, 10				
846A	Remote manipulation	1	180/wk	180/wk	1
		1	30/dy		1
121	Mass meas, macro (4)/30, 30, 0.5				
9A	Organism mass measurements	1	10/dy	10/dy	0
24B	Water consumption - vol or mass bag/bot	1	46/wk	40/wk	0
29A	Mass measurements (10-1000 gms) containd l & s	1	27/dy	27/dy	1
		1	45/dy		1
122	Mass meas, micro (4)/10, 15, 0.5				
9A	Organism mass measurements	1	15/dy	15/dy	0
28A	Mass msmts of containd liq & solid (.001-100 gm)	1	18/dy	18/dy	0
505A	Water analysis, total solids content	1	5/dy	5/dy	0
		2	38/dy		0
122A	Mass, test (93)/*				
840A	Max mass transportable - SS	5	180/wk	*	*
840B	Max mass transportable - p. suited	5	(see above)		
841A	Max vol transportable - SS	5	(see above)		
841B	Max vol transportable - p. suited	5	(see above)		
842A	Max MOI transportable - SS	5	(see above)		

Table III-2. Equipment Operations Analysis, Contd
Maxi Max Payload

REF. NO.	EQUIPMENT ITEM (EU)/INVENTORY WT., PWR., VOL.	NO. REQ.	CREW USE TIME MIN/X	EQUIP. "ON" TIME MIN/X	AVE PWR WATTS
	842B Max MOI transporable - p suited	5	(see above)		
	843A Max mass alignable - SS	5	180/wk		
	843B Max mass alignable - p. suited	5	(see above)		
	844A Max vol alignable - SS	5	(see above)		
	844B Max vol alignable - p. suited	5	(see above)		
	845A Max MOI alignable - SS	5	(see above)		
	845B Max MOI alignable - p. suited	5	(see above)		
		5	60/dy		
123	Media, dehydrtd (61)/10, 0, 1				
	79A Organism subculture-substrate prep	1	190/wk	0	0
	87A Microorganism identification	1	150/wk	0	0
		1	57/dy		0
124	Media, prepared (61)/30, 0, 1				
	81B Media preparation, cells & tissues	6	60/wk	0	0
		6	10/dy		0
124A	Media pouring table, AG (4)/20, 50, 2				
	79A Organism subculture, substrate prep.	1	190/wk	100/wk	1
		1	32/dy		1
ad					
125A	Medium substrate plant (51)/10, 0, 1				
	80A Organism subculture, plants	8	30/dy	0	0
		8	30/dy		0
125B	Meters, assorted (5)/*				
	49A Pressure monitoring - meters vis readout		4/dy	*	*
	66C Animal activity - activity wheel monitr		a		
	512A Electrical amperage msmts		2/hr		
		60	24/dy		
ad					
125D	Metabolic analyzer fixed (31)/40, 30, 3				
	310A Bicycle ergometry	1	538/wk	538/wk	2
	330A Respiratory dead space, alvlr. vent., etc.	1	35/2 wk	30/2 wk	0
		1	93/dy		2
ad					
126	Micoscp, compnd (1)/12.5, 25, 0.8				
	40A Blood morphology and cell counts	1	172/wk	172/wk	0
	85B Starch granule assay	1	15/wk	15/wk	0
	87A Microorganism identification	1	150/wk	150/wk	0
	108C Bacterial cell counting - vital staing	1	30/mo	30/mo	0
	186A Cytochemical staining, animal systems	1	160/wk	160/wk	0
	348A Gonad histopathology	1	95/2 wk	90/2 wk	0
		1	92/dy		1
126A	Microscp, disctng (4)/20, 63, 1				
	78A Invertebrate counting and sorting (insects)	1	30/dy	30/dy	1
		1	30/dy		1
126B	Microphone (5)/0.1, 0, .01				
	64A Noise monitoring	4	a	0	0
	161A Arterial blood pressure	3	15/3 dy	0	0
	730A Cognitive/complex perceptual, speech intell.	2	15/wk	0	0
	731A Cognitive/complex perceptual, reading	2	16/wk	0	0
	759C Fine psychomtr, speaking ability	2	15/wk	0	0
	792A Individual behavior - periodic monitoring	10	5/dy	0	0
	793A Individual behavior - periodic monitoring	10	5/dy	0	0
	794A Individual behavior - periodic monitoring	10	5/dy	0	0
	795A Individual behavior - periodic monitoring	10	5/dy	0	0
	796A Individual behavior - periodic monitoring	10	5/dy	0	0
	797A Individual behavior - periodic monitoring	10	5/dy	0	0
	798A Individual behavior - periodic monitoring	10	5/dy	0	0
	799A Individual behavior - periodic monitoring	10	5/dy	0	0
	800A Individual behavior - periodic monitoring	10	5/dy	0	0
	801A Individual behavior - periodic monitoring	10	5/dy	0	0
	802A Individual behavior - periodic monitoring	10	5/dy	0	0
	805B Group behavior - verbal interactions	10	5/dy	0	0
	806B Group behavior - verbal interactions	10	5/dy	0	0
	807B Group behavior - verbal interactions	10	5/dy	0	0
	808B Group behavior - verbal interactions	10	5/dy	0	0
		17	88/dy		0

Table III-2. Equipment Operations Analysis, Contd
Maxi Max Payload

REF. NO.	EQUIPMENT ITEM (EU)/INVENTORY WT., PWR., VOL.	NO. REQ.	CREW USE TIME MIN/X	EQUIP. "ON" TIME MIN/X	AVE PWR WATTS
126C	Microphone amplifier (5)/0.1, 10, .01				
161A	Arterial blood pressure	10	75/3 dy	75/3dy	0
		10	25/dy		0
126E	Mirror mount - commutatr (1)/0.2, 5, .01				
16A	Setup camera optical commutation	30	1365/90dy	1350/90dy	0
65A	Plant activity - time lapse video	12	a	1/hr	1
65B	Plant activity - time lapse photo	6	a	1/hr	1
169A	TV monitoring routine and for data B/W	102	a	1/10c	51
		102	18/dy		53
126G	Monitor, video (1)/20, 50, 2				
15A	Camera setup	1	30/dy	10/dy	0
32A	Specimen status observation	1	102/dy	102/dy	4
222B	Vertebrate experiment initiation	1	300/90dy	150/90dy	0
224B	Invertebrate experiment initiation	1	300/90dy	150/90dy	0
225B	Cells and tissue experiment setup	1	300/90dy	150/90dy	0
223B	Plant experiment initiation	1	300/90dy	150/90dy	0
		6	19/dy		4
126I	Mobility unit - protct corrd (93)/*				
840A	Max mass transportable	2	180/wk	*	*
841A	Max vol transportable	2	(see above)		
842A	Max MOI transportable	2	(see above)		
843A	Max mass alignable	2	180/wk		
844A	Max vol alignable	2	(see above)		
845A	Max MOI alignable	2	(see above)		
		2	60/dy		
128	Millipore filter apparatus (4)/2, 0, 0,1				
98B	Distalled/sterile water prep	1	a	0	0
100C	Sterilizer of media - filtration	1	15/wk	0	0
		1	3/dy		0
131	Mixer, chemcls (4)/10, 30, 0.5				
79A	Organism subculture - substrate prep	1	190/wk	100/wk	0
ad		1	32/dy		0
131B	Mortar pestle and sand (4)/2, 0, 0.1				
143A	Plant homogenation	1	45/wk	0	0
		1	8/dy		0
131D	Motor, plnt growth mntr (51)/1, 5, .02				
65D	Plant activity - make/break incremtl motor	32	a	15/dy	2
		32	a		2
131E	Non-visual dirctn indicatr (12)/9, 0, 1				
307A	Spatial localization	1	150/wk	0	0
		1	25/dy		0
131H	Optiscan-field and fixtn (91)/5, 5, 0.3				
825A	Eye movement measurements, optical	1	30/wk	30/wk	0
		2	5/dy		0
132	Oscilscpe (DC-5 MHZ) (2)/20, 100, 1				
14A	Bioelectric Xdcr installaton-manl calib	1	20/dy	10/dy	1
14B	Bioelectric Xdcr installaton-precalib	1	85/wk	25/wk	0
312B	Electronic equipment calib-in place	1	30/wk	30/wk	0
		2	39/dy		1
132A	Oscillator VCO (42)/0.1, 0, .01				
17B	Monitor ECG-hardwire multiplex data to DM		9/wk	0	0
18B	Monitor EEG-hardwire multiplex data to DM		9/wk	0	0
19B	Monitor EMG-hardwire multiplex data to DM		9/wk	0	0
ad		70	5/dy		0
133	Otolith test goggle (12)/1, 0, 0.1				
307A	Spatial localization	1	150/wk	0	0
318A	Oculogyral illusion	1	105/wk	0	0
345A	Angular acceleration threshold	1	105/wk	0	0
		1	60/dy		0

Table III-2. Equipment Operations Analysis, Contd
Maxi Max Payload

REF. NO.	EQUIPMENT ITEM (EU)/INVENTORY WT., PWR,, VOL.	NO. REQ.	CREW USE TIME MIN/X	EQUIP. "ON" TIME MIN/X	AVE PWR WATTS
134	Oven, drying (6)/40, 600, 2				
	48A Antibody titration-interfacial test in agar	1	22/wk	22/wk	1
	148B Thermal control of chemical preparatns	1	5/dy	15/dy	6
		1	9/dy		7
ad					
137	pH coupler (5)/0.4, 2, .036				
	357A Gastric pressure and pH	20	75/wk	75/wk	0
		20	13/dy		0
138	pH mtr (5)/8.5, 9, .75				
	81B Media preparation-cells and tissues	1	60/wk	60/wk	0
	504A Water analysis, pH measurement	1	5/4hr		0
		2	20/dy		0
ad					
138B	Phototransistor (6)/*				
	71B Light monitoring, on/off and intensity	400	a	*	*
		400	a		
139	Plethysmograph, limb (31)/5, 5, 0.2				
	304A Lower body negative pressure	1	435/wk	420/wk	0
	365A Venous compliance	1	35/wk	30/wk	0
		2	78/dy		0
139A	Pneumotachograph (31)/5, 10, 0.4				
	331A Respiratory airway resistance	1	35/2 wk	30/2wk	0
	332A Lung compliance	1	35/2 wk	30/2wk	0
		1	6/dy		0
140	Coupler phono/vibrocardgrm (30)/0.2, 1, .01				
	320A Phono/vibrocardgrm-discrete units		50/3dy	50/3dy	0
	320B Phono/vibrocardgrm-EP backpk, man		50/3dy	50/3dy	0
		4	33/dy		0
142	Portable LSS (PLSS) (80)/67, 0, 2.8				
	521B Pressure suit ventilation and cooling - PLSS	3	45/2wk	0	0
		3	4/dy		0
143A	Power supply (3)/100, 0, 2				
	15A Camera setup	1	10/dy	0	0
	169A TV monitoring routine and for data B/W	1	a	0	0
		2	10/dy		0
143C	Pump, gas circulatng (51)/1, 5, .02				
	91A Plant radiochemistries	16	320/2wk	c	80
		16	27/dy		80
143D	Purge sys, cat burn (4)/*				
	125A Crew/chemical isolation - LFB	1	30/dy	*	*
	125B Crew/chemical isolation - glove box std	1	20/dy		
		1	50/dy		
143E	Pressurecuff w/Xdcr (42)/0.5, 0, .05				
	161A Arterial blood pressure	2	75/3dy	0	0
		2	25/dy		0
143F	Pressurecuff pump (42)/1, 20, 0.1				
	161A Arterial blood pressure	2	75/3dy	75/3dy	0
		2	25/dy		0
143G	Coupler-pressure transducr (5)/0.1, 1, .01				
	322A Venous blood pressure		95/2wk	90/2wk	0
	357A Gastric pressure and pH		75/wk	75/wk	0
		52	20/dy		0
143H	Pressure suit connectr (11)/2, 0, 0.1				
	521A Pressure suit ventilation and cooling -PLSS	6	180/2wk	0	0
		6	15/dy		0
143I	Pressure suit manipulation aids (11)/20, 0, 1				
	520A Pressure suit donning and doffing	1	180/2wk	0	0
		1	15/dy		0

Table III-2. Equipment Operations Analysis, Contd
Maxi Max Payload

REF. NO.	EQUIPMENT ITEM (EU)/INVENTORY WT., PWR., VOL.	NO. REQ.	CREW USE TIME MIN/X	EQUIP. "ON" TIME MIN/X	AVE POWER WATTS
144	Psychomtr perf console (91)/100, 100, 4				
760A	Fine psychmtr, manipability, arm steadiness	1	15/wk	15/wk	0
761A	Fine psychmtr, manipability, wrist/finger speed	1	4/wk	3/wk	0
762C	Fine psychmtr, manipability, finger dexterity	1	10/wk	6/wk	0
763C	Fine psychmtr, manipability, manual dexterity	1	6/wk	3/wk	0
764C	Fine psychmtr, gross positining ability, positn est.	1	6/wk	3/wk	0
766A	Fine psychmtr, gross positining ability, control prec.	1	8/wk	6/wk	0
767C	Fine psychmtr, gross positining ability, arm mvmt spd	1	4/wk	3/wk	0
768A	Fine psychmtr, gross positining ability, multilimb coord	1	11/wk	9/wk	0
769C	Fine psychmtr, gross positining ability, positn repro	1	6/wk	3/wk	0
770A	Fine psychmtr, reaction time, simple	1	7/wk	6/wk	0
771A	Fine psychmtr, reaction time, complex	1	7/wk	3/wk	0
791A	Sleep behavior, response to emergency	1	45/mo	30/mo	0
		1	16/dy		1
ad					
144C	Radiatn detctr, dosmtr (25)/5, 10, .25				
63C	Radiation monitoring - rate monitoring	4	30/mo	30/mo	0
		4	1/dy		0
ad					
147	Radiatn detectr, scint (25)/40, 100, 2				
91A	Plant radiochemistries	1	320/2wk	320/2wk	2
92A	Vertebrate radiochemistries	1	320/2wk	320/2wk	2
93A	Invertebrate radiochemistries	1	320/2wk	320/2wk	2
94A	Cells and tissue radiochemistries	1	320/2wk	320/2wk	2
335A	Erythrocyte survival	1	285/mo	270/mo	1
		1	117/dy		9
147B	Radiatn, room (25)/1100,1000, 50				
126A	Crew radiation isolation	1	240/2wk	240/2wk	12
162A	X-ray diagnostic	1	25/2dy	75/2dy	26
163A	Radiation exposure	1	240/2wk	240/2wk	12
		1	53/dy		50
147C	Radiatn room rack sys (26)/50, 0, 5				
163A	Radiation exposure	1	240/2wk	0	0
		1	20/dy		0
149	Radiation system, photon (25)/100, 100, 5				
351A	Bone densitometry, photon absorpton	1	30/2wk	30/2wk	0
		1	3/dy		0
ad					
149F	Radiatn srce, isotope (26)/120, 50, 0.5				
163A	Radiation exposure	1	240/2wk	240/2wk	1
		1	20/dy		1
149G	Radiatn source, prepkgd (26)/200, 30, 0.5				
335A	Erthrocyte survival	1	285/mo	270/mo	1
		1	11/dy		1
149H	Radiation whole body scan (26)/80,100, 8				
335A	Erthrocyte survival	1	285/mo	270/mo	1
351A	Bone densitometry-photon absorption	1	30/2wk	30/2wk	0
352A	Radioisotope counting, whole body	1	150/2wk	135/2wk	1
		1	26/dy		2
150	Radiatn, source stor (25)/100, 0, 1				
91A	Plant radiochemistries	1	320/2wk	0	0
92A	Vertebrate radiochemistries	1	320/2wk	0	0
93A	Invertebrate radiochemistries	1	320/2wk	0	0
94A	Cells and tissues radiochemistries	1	320/2wk	0	0
163A	Radiation exposure	1	240/2wk	0	0
335A	Erthrocyte survival	1	285/mo	0	0
		2	138/dy		0
ad					
150B	Receiver-exg, cage mod (42)/0.1, 10, 0.1				
17C	Monitor ECG-Xmtr on organsm/recvr at cm	6	20/wk	c	60
18C	Monitor EEG-Xmtr on organsm/recvr at cm	6	20/wk	(see above)	
19C	Monitor EMG-Xmtr on organsm/recvr at cm	6	20/wk	(see above)	
		32	10/dy		60
150D	Receivers 100-5 MHZ (3)/5, 20, 0.5				
115A	Electromagnetic assay	5	a	1/10c	2
		5	a		2
150F	Rcrdr, electm, 100-5 MHz (2)/5, 20, 0.5				
115A	Electromagnetic assy	1	a	1/10c	2
		1	a		2

Table III-2. Equipment Operations Analysis, Contd
Maxi Max Payload

REF. NO.	EQUIPMENT ITEM (EU)/INVENTORY WT., PWR., VOL.	NO. REQ.	CREW USE TIME MIN/X	EQUIP. "ON" TIME MIN/X	AVE PWR WATTS
150G	Rcrdr, electm, 0-100 Hz (2)/5, 20, 0.5				
115A	Electromagnetic assay	1	a	1/10c	2
		1	a		2
152A	Room, private for grnd communication (91)/*				
792D	Individual behavior - interviews by grnd	1	30/wk	*	*
793D	Individual behavior - interviews by grnd	1	30/wk		
794D	Individual behavior - interviews by grnd	1	30/wk		
795D	Individual behavior - interviews by grnd	1	30/wk		
796D	Individual behavior - interviews by grnd	1	30/wk		
797D	Individual behavior - interviews by grnd	1	30/wk		
799D	Individual behavior - interviews by grnd	1	30/wk		
800D	Individual behavior - interviews by grnd	1	30/wk		
801D	Individual behavior - interviews by grnd	1	30/wk		
802D	Individual behavior - interviews by grnd	1	30/wk		
798D	Individual behavior - interviews by grnd	1	30/wk		
		1	55/dy		
153	Rcrdr, voice (12)/5, 50, 0.5				
730A	Cognitive/complex perceptual, speech intell	1	15/wk	15/wk	0
731A	Cognitive/complex perceptual, reading	1	16/wk	15/wk	0
759C	Line psychomtr, speaking ability	1	15/wk	15/wk	0
792A	Individual behavior-periodic monitoring	10	a	5/dy	2
793A	Individual behavior-periodic monitoring	10	a	5/dy	2
794A	Individual behavior-periodic monitoring	10	a	5/dy	2
795A	Individual behavior-periodic monitoring	10	a	5/dy	2
796A	Individual behavior-periodic monitoring	10	a	5/dy	2
797A	Individual behavior-periodic monitoring	10	a	5/dy	2
798A	Individual behavior-periodic monitoring	10	a	5/dy	2
799A	Individual behavior-periodic monitoring	10	a	5/dy	2
800A	Individual behavior-periodic monitoring	10	a	5/dy	2
801A	Individual behavior-periodic monitoring	10	a	5/dy	2
802A	Individual behavior-periodic monitoring	10	a	5/dy	2
805B	Group behavior-periodic monitoring	10	a	(see above)	
806B	Group behavior-periodic monitoring	10	a	(see above)	
807B	Group behavior-periodic monitoring	10	a	(see above)	
808B	Group behavior-periodic monitoring	10	a	(see above)	
		10	8/dy		22
153A	Rotating litter chair (RLC)(12)/265, 180, 38				
306A	Ear canal caloric stimulation	1	90/wk	0	0
307A	Spatial localization	1	150/wk	150/wk	3
311A	Body restraint/motion device	1	5/wk	0	0
316A	Agravic perception	1	105/wk	105/wk	2
317A	Ocular counter-rolling	1	180/wk	180/wk	3
318A	Oculogyral illusion	1	105/wk	105/wk	2
345A	Angular acceleration threshold	1	105/wk	105/wk	2
356B	Subject instrumentation and cleanup	1	30/dy	0	0
358B	Biomedical equipment cleanup/disp.	1	15/dy	0	0
364B	Visual task with head rotation	1	195/wk	195/wk	4
		1	201/dy		16
153B	Sensors, assorted (6)/*				
57C	Atmos water monitoring - specific sensrs	2	10/dy	*	*
165B	Event monitoring - specific sensors	19	a		
196B	Primate cage preparation	1	240/90dy		
508A	Vacuum supply	2	a		
		24	13/dy		
ad					
155A	Sensor, implntd (42)/0.1, 0, .001				
218B	Deep body temperature	102	a	0	0
		102	a		0
155B	Shroud, environmental (81)/10, 0, 0.5				
516A	Atmospheric gas isolation	1	5/wk	0	0
		1	1/dy		0
156	Signl cond (couplr) (2)/0.2, -, .01				
	Multiple functions	1730			
		1730			
156A	Stain apparatus, wrights (4)/15, 50, 1.5				
40A	Blood morphology and cell counts	1	172/wk	172/wk	1
ad		1	29/dy		1

Table III-2. Equipment Operations Analysis, Contd
Maxi Max Payload

REF. NO.	EQUIPMENT ITEM (EU)/INVENTORY WT., PWR., VOL.	NO. REQ.	CREW USE TIME MIN/X	EQUIP. "ON" TIME MIN/X	AVE PWR WATTS
156E	Signl cond rack (41)/5, 0, 0.8				
	129A Holding, primates - module primate	104	a	0	0
		104	a		0
157	Sound level meter (5)/30, 0, 1.4	5	a	0	0
	64A Noise Monitoring	5	a		0
158A	Space suit supply consol (80)/30, 100, 4				
	840B Max mass transportable - suited (press)	1	90/wk	60/wk	1
	841B Max vol transportable - suited (press)	1	90/wk	60/wk	1
	842B Max MOI transportable - suited (press)	1	90/wk	60/wk	1
	843B Max mass alignable suited (press)	1	90/wk	60/wk	1
	844B Max vol alignable suited (press)	1	90/wk	60/wk	1
	845B Max MOI alignable suited (press)	1	90/wk	60/wk	1
		2	90/dy		6
159	Staing sys, bacterlgcl (4)/15, 50, 1.5				
	88A Bacterial smear staining	1	250/wk	250/wk	1
		1	42/dy		1
160	Stain sys, (embd/rins) (4)/100, 40, 4				
	89A Histological sectioning	1	50/wk	50/wk	0
	90A Histological staining	1	13/wk	13/wk	0
	186A Cytochemical staining, animals	1	160/wk	160/wk	1
		1	37/dy		1
161A	Staining sys, plants (4)/20, 50, 2				
	85B Starch granule assay	1	15/wk	15/wk	0
	185A Cytochemical staining plants	1	160/wk	160/wk	1
		1	29/dy		1
162	Sterilzr, autoclave, stm (6)/38, 300, 3				
	79A Organism subculture, substrate prep	1	190/wk	1/2c	150
	80A Organism subculture, plants	1	30/dy	(see above)	
	82A Workbench cleanup	1	45/dy	(see above)	
	83C Workbench sterilization - liners	1	50/dy	(see above)	
	97A Experiment waste mgmt	1	30/dy	(see above)	
	100A Sterilizer of media - autoclave	1	40/wk	(see above)	
	196B Primate cage preparation	1	10/90dy	(see above)	
	370A Viral culturing	1	210/2wk	(see above)	
	371A Viral identification	1	130/2wk	(see above)	
	372A Fungal culturing	1	130/2wk	(see above)	
	373A Fungal identification	1	130/2wk	(see above)	
		1	243/dy		150
165	Sterlzr, tool (6)/1, 500, 0.1				
	84A Organism subculturing-cells & tissue	1	67/dy	64/dy	22
		1	67/dy		22
167B	Storage, genl (7)/3.4, 0, 1				
	79A Organism subculture, substrate prep		190/wk	0	0
	80A Organism subculture, plants		30/dy	0	0
	83C Workbench sterilization - liners		50/dy	0	0
		81	112/dy		0
167C	Storage, film (7)/50, 0, 1				
	63A Radiation monitoring - film sensors	1	110/wk	0	0
	65B Plant activity - time lapse photo	1	a	0	0
	162A X-ray diagnostic	1	25/2dy	0	0
		1	31/dy		0
168	Stove (4)/5, 1000, 1				
	79A Organism subculture, substrate prep	1	190/wk	190/wk	19
	505A Water analysis, total solids content	1	5/dy	2/dy	1
		1	37/dy		20
168A	Tags, ID, organism (6)/*				
	68A Organism identification film	1128	a	*	*
		1128	a		

Table III-2. Equipment Operations Analysis, Contd
Maxi Max Payload

REF. NO.	EQUIPMENT ITEM (EU)/INVENTORY WT., PWR., VOL.	NO. REQ.	CREW USE TIME MIN/X	EQUIP. "ON" TIME MIN/X	AVE PWR WATTS
176G	Taskboard, maint/gross coord (91)/20, 0, 3				
	780A Gross psychomotor, gross body coord	2	16/wk	0	0
		2	3/dy		0
176H	Taskboard, force/torque (91)/50, 5, 4				
	776B Gross psychomotor, muscle strength, impul	2	30/3k	30/wk	0
	777B Gross psychomotor, muscle strength, sust.	2	30/wk		0
		2	10/dy		0
177	T sens, body (42)/0.2, 0, -				
	22A Temperature msmts - thermocouples		a	0	0
	22B Temperature msmts - thermisters		a	0	0
		95	a		0
179	Temp block (4)/7.5, 100, .15				
	33A Blood preparation	4	32/dy	1/2c	200
	334A Clotting time	1	15/2wk	(see above)	
		4	33/dy		200
179A	Thermcouples (5)/0.1, 0, .001				
	57D Atmos water monitoring-dew point sys		a	0	0
	70A Air movement		a	0	0
		8	a		0
179C	Timer, integral equipment (91)/1, 0, .02				
	820B Task completion times - integral timers	20	10/dy	0	0
	830C Frequency of equipment/facility util.	20	5/wk	0	0
	831C Length of use of equipment/facility	20	5/wk	0	0
		20	12/dy		0
180	Timer, event (2)/0.5, 1, .01				
	310A Bicycle ergometry	1	538/wk	538/wk	0
	342A Plasma coagulation	1	35/wk	30/wk	0
	779A Gross psychmtr, gross body equilibrium	1	16/wk	15/wk	0
	782A Gross psychmtr, speed of limb mvmt.	1	4/wk	3/wk	0
	791A Sleep behavior, response to emergency	1	45/mo	45/mo	0
	820A Task completion times - subjt or exp. timer	1	10/dy	10/dy	0
		2	111/dy		0
ad					
181A	Xdcr blood flow (42)/0.1, 1, .001				
	20B Respiratory rate monitoring - plythesmograph	12	60/wk	60/wk	0
		12	10/dy		0
181B	Transducer - plythesmgph (42)/1, 1, .01				
	49B Pressure monitoring	22	a	c	22
		22	a		22
181C	Xdcr blood pressure (42)/0.1, 1, .036				
	164A Peripheral venous blood pressure	22	60/wk	10/wk	0
		22	10/dy		0
181D	Transducer, pressure (6)/0.1, 1, .036				
	824A Forces, pressures, and torques exerted	90	5/dy	5/dy	0
		90	5/dy		0
181E	Video ID date-time sys (1)/*				
	65A Plant activity, time lapse video	1	a	*	*
	66A Animal activity, time lapse video	1	a		
		1	a		
181G	Trash can (6)/1, 0, 1				
	518A Trash disposal	4	2/dy	0	0
		4	2/dy		0
182A	Urine collector sys (40)/40, 0, 2				
	5A Urine mgmt at cage	1	a	0	0
		1	a		0
182D	Urine pad holder (40)/0.2, 0, .01				
	5A Urine mgmt at cage	532	a	0	0
		532	a		0
182G	Urine pads (40)/0.1, 0, .001				
	5A Urine mgmt at cage	2500	a	0	0
	6A Urine mgmt, cage to disposal	2500	a	0	0
		2500	a		0

Table III-2. Equipment Operations Analysis, Contd
Maxi Max Payload

REF. NO.	EQUIPMENT ITEM (EU)/INVENTORY WT., PWR., VOL.	NO. REQ.	CREW USE TIME MIN/X	EQUIP. "ON" TIME MIN/X	AVE PWR WATTS
182H	Valves, assorted (80)/1, 0, .05				
	508A Vacuum supply	20	a	0	0
		20	a		0
182I	Space vacuum xtraveh tube (5)/50, 0, 1				
	125A Crew/chemical isolation - LFB	1	30/dy	0	0
	125B Crew/chemical isolation - glove box std	1	20/dy	0	0
	304A Lower body negative pressure	1	435/wk	0	0
		1	123/dy		0
182J	Coupler, vectorcardiogram (31)/0.1, 1, .036				
	319A Vectorcardiogram - discrete units	1	50/3dy	50/3dy	0
	319B Vectorcardiogram - EP backpack, man	1	50/3dy	50/3dy	0
		2	33/dy		0
182K	Vision testr (91)/50, 100, 4				
	700A Visual, acuity, static	1	6/wk	6/wk	0
	701A Visual, acuity, dynamic	1	6/wk	6/wk	0
	702A Visual, stereopsis, static	1	6/wk	6/wk	0
	703A Visual, stereopsis, dynamic	1	6/wk	6/wk	0
	704A Visual, brghtness threshd, absolute	1	6/wk	6/wk	0
	705A Visual, brightness discrimination	1	6/wk	6/wk	0
	706A Visual, color perception	1	3/wk	3/wk	0
	707A Visual, CFFF	1	6/wk	6/wk	0
	708A Visual, phorias	1	6/wk	6/wk	0
	709A Visual, glare recovery	1	6/wk	6/wk	0
	710A Visual, dark adaptation	1	60/wk	60/wk	1
	713A Visual, peripheral field	1	9/wk	9/wk	0
	714A Visual, accommodation range	1	6/wk	6/wk	0
		2	22/dy		1
ad					
185	Voltmtr (VOM) (6)/13.5, 35, 0.5				
	511A Electrical continuity and volt. msmts	3	3/wk	3/wk	0
		3	1/dy		0
ad					
186A	Vomitus bags and holders (31)/1, 0, .025				
	300A Vomitus collection	18	ar	0	0
		18			0
187	Waste mngmt sys (3)/*				
	82A Workbench cleanup	1	45/dy	*	*
	84A Organism subculturing, c and T	1	67/dy		
	96A Radiochem waste mgmt	1	15/2 wk		
		1	113/dy		
999	Experiment specific (99)/*				
	Multiple functions			*	*

Table III-2. Equipment Operations Analysis (Addendum A)

REF. NO.	EQUIPMENT ITEM (EU)/INVENTORY WT., PWR., VOL.	NO. REQ.	CREW USE TIME, MIN/X	EQUIP "ON" TIME, MIN/X	AVE PWR WATTS
011B	Anlzr, protein (5)/75, 100, 2				
	177A Protein assy - auto analyzer	1	9/wk	9/wk	0
		1	2/dy		0
014A	Animal maze, rat (42)/5, 0, 0.5				
	206A Vertebrate behavior study-small verts	1		0	0
		1			0
016A	Audio-vis tactl stim (42)/5, 20, 0.5				
	206A Vertebrate behavior study-sml v.	1	50/wk	15/wk	0
	206B Vertebrate behavior study-primate	1	60/wk	15/wk	0
		1	18/dy		0
016C	Behavior unit, prim (42)/20, 100, 1				
	206B Vertebrate behavior study-primate	2	60/wk	15/wk	0
		2	10/dy		0
025	Cage, Inverts, (jars) (70)/ 1, 0, 0.48				
	136A Holding Invertebrates	8	a	0	0
	199C Invertebrate cage and h.u. setup-in space	8		0	0
		8			0
026A	Cage MMB, C/T (60)/1, 5, 0.03				
	200C C/T Holding Unit prep-in space	1	480/90dy	480/90dy	0
		16	6/dy		0
029	Cage, plant, pot (50)/10, 0, 2				
	133A Holding unit plant	8	a	0	0
	198C Plant holding unit prep-in space	8		0	0
		8			0
038A	Camera X-Y drive (1)/5, 20, 0.4				
	16C Setup camera optical commut.-camera drv.	5	195/90dy	5/90dy	0
	16D Setup camera optical commut.-grnd setup	25	125/90dy	5/90dy	0
		104	4/dy		0
039	Chromatograph, liquid column (4)/10, 0, 1				
	187A Nucleic acid assy	1		0	0
		1			0
047	Cleanr, ultrsnc (6)/20,415, 1				
	82A Work bench cleanup	1	45/dy	15/dy	4
		1	45/dy		4
054	Countr, colony, manual (5)/10, 50, 0.5				
	506A Water analysis - bacteriological assy	1	20/dy	20/dy	1
		1	20/dy		1
056A	Data mngmt sys, buses (2)/*				
	525A Data management	1	a	*	*
		1	a		
058	Data MS, plot/print (2)/55, 280, 2.6				
	43B Digital records - std meters and recrdr	1	a	5/dy	1
	44B Analog records - strip chart recrdrs	1	a	5/dy	1
	73B Data storage - computer memory core	1	a	15/dy	3
		3	a		5
058B	Data mngmt sys (2)/ *				
	525A Data management	30	a	*	*
		30	a		
069A	Electrometer (6)/17, 46, 0.6				
	196B Primate cage prep-in space	1	120/90dy	60/90dy	0
	197B Vertebrate cage prep-in space	1	15/90dy	15/90dy	0
	198C Plant H. Unit prep-in space	1	15/90dy	15/90dy	0
	199C Invertebrate cage and H.U. setup-in space	1	15/90dy	15/90dy	0
	200C C and T H. Unit prep-in space	1	15/90dy	15/90dy	0
	511A Electrical continuity and volt msmts	1	3/wk	3/wk	0
		1	3/dy		0

Table III-2. Equipment Operations Analysis, Contd (Addendum A)

REF. NO.	EQUIPMENT ITEM (EU)/INVENTORY WT., PWR., VOL.	NO. REQ.	CREW USE TIME, MIN/X	EQUIP "ON" TIME, MIN/X	AVE PWR WATTS
075	Feedr, plnt, auto (51)/0.5, 5, .01				
	60A Plant feeding and watering-auto	192	a	1/dy	1
	198C Plant H. Unit prep-in space	1	15/90dy	15/90dy	0
		192	1/dy		1
076	Feedr, plant, manual (51)/1.0, 0, .003				
	198C Plant holding unit prep-in space	64		0	0
		64			0
076H	Flowmeter coupler, water manifld (3)/0.1, 1, .036				
	24A Water consumption - flowmtr	24	a	c	24
		24	a		24
076L	Fibrometer - blood clot (5)/10, 40, 0.7				
	426A Prothrombin consumption	1	20/2wk	20/2wk	0
		1	2/dy		0
077B	Frezr, cryo (4)/68, 0, 1.3				
	207A Experiment termination, primates	1		0	0
	208A Experiment termination, small verts	1		0	0
	209A Experiment termination, plants	1		0	0
	210A Experiment termination, c and t	1		0	0
	211A Experiment termination, inverts	1		0	0
		1			0
084	Frig, radio chem storag (4)/100, 15, 7				
	91A Plant radiochemistries	1	320/2wk	c	15
	92B Vertebrate radiochemistries	1	320/2wk	(see above)	
	93B Invertebrate radiochemistries	1	320/2wk	(see above)	
	94B C and T radiochemistries	1	320/2wk	(see above)	
		1	106/dy		15
093	Gas anlzr, RH (5)/2.5, -, 0.25				
	57C Water vapor monitoring-specific sensors	4	10/dy	0	0
		4	10/dy		0
104C	Indicator, labstix (4)/0.5, 0, 0.1				
	149B Urine analysis-manual	1		0	0
		1			0
104F	Impedance pneumograph (30)/0.5, 1, 0.1				
	414B Impedance pneumograph for man	1			0
		1			0
114A	Kit, microdissection (4)/10, 0, 1				
	114A Cytoplasmic streaming, plants	1		0	0
	208A Experiment termination, small verts	1		0	0
	209A Experiment termination, plants	1		0	0
	210A Experiment termination, c and t	1		0	0
	211A Experiment termination, inverts	1		0	0
		1			0
115A	Lgt discrim apprtus (42)/8, 25, 0.1				
	206B Vertebrate behavior study-primate	1	60/wk	15/wk	0
		1	10/dy		0
118D	Manifld, organism, water (40)/*				
	130A Holding, mice	1	a	*	*
	131A Holding, rats, quail	1	a		
	134A Holding, rabbits, cats, marmots	1	a		
		1	a		
125	Media prep contnrs (61)/1.0, 0, 0.5				
	81A Media prep, cells and tissue	18		0	0
		18			0
125C	Meter, AO TS (5)/1.0, 0, 0.01				
	149B Urine analysis-manual	1		0	0
		1			0
125F	Microscope-holographic (1)/100, 200, 8				
	77C Microscopy general-holographic	1	30/dy	30/dy	4
		1	30/dy		4

Table III-2. Equipment Operations Analysis, Contd (Addendum A)

REF. NO.	EQUIPMENT ITEM (EU)/INVENTORY WT., PWR., VOL.	NO. REQ.	CREW USE TIME, MIN/X	EQUIP "ON" TIME, MIN/X	AVE PWR WATTS
132B	Oven, vacuum 40-80C (6)/40, 500, 1				
	89B Histological sectioning	1	50/wk	50/wk	2
		1	8/dy		2
134B	Paper, recording (1)/50, 0, 3				
	43B Digital records - std metrs and rcdrs			0	0
	44B Analog records - std metrs and rcdrs			0	0
		7			0
138A	Photocells (6)/*				
	71A Light monitoring - photocells	200	a	*	*
		200	a		
144B	Psychogalvanomtr GSR (12)/1, 1, 0.01				
	400A Galvanic skin respons (GSR)	2			0
		2			0
145	Radiatn detectr, general (25)/3, 1, 0.2				
	63C Radiation monitoring - rate	6	30/mo		0
		6	1/dy		0
149D	Radiatn srce, X-ray elec (26)/55, 1500, 3.0				
	162B X-ray diagnostic	1	25/2dy	25/2dy	13
		1	13/dy		13
150A	Recorder multichn biomed (1)/150,230, 2				
	43B Digital records - std meters and recrdr	1	a	30/dy	5
	44B Analog records - strip chart recrdr	1	a	30/dy	5
		1	a		10
154A	Restraint chair, primate (42)/10, 0, 4				
	206B Vertebrate behavior study	2		0	0
		2			0
156B	Squibs, fixative (51)/0.1, 0, .001				
	85A Starch granule assy-fix in situ	16	a	0	0
		16	a		0
156C	Squib firing apparatus (51)/0.2, 0, .01				
	85A Starch granule assy-fix in situ	6	a	0	0
		6	a		0
170	Strain gage, mus skel (42)/0.1, 0, .001				
	25A Musculoskeletal tonus	1		0	0
		1			0
176	Tape, video (2)/100, 0, 4				
	40C Blood morphology and cell count-cmptr			0	0
	65A Plant activity-time lapse video			0	0
	66A Animal activity-time lapse video			0	0
	169A TV monitoring, routine and for data			0	0
	170A TV monitoring, ad hoc, color			0	0
		10			0
181	Toxic fluid hndlng sys (4)/300, 150, 12				
	85B Starch granule assy-manual fixatn	1	15/wk	15/wk	0
	89B Histological sectioning	1	50/wk	50/wk	1
	105A Organism or sample presvn with chem.	1	8/dy	8/dy	1
	173A Plant lipids - gas chromatography	1	70/mo	70/mo	0
	180A Plant hormones - chromatography	1	80/2wk	80/2wk	1
		1	28/dy		3
183A	Visual cliff (42)/5, 0, 15.6				
	206A Vertebrate behavior study-small verts	1		0	0
		1			0
186	Volmtrc meas, liq (4)/5, 0, 1.5				
	418B Urine volume	1		0	0
	420A Caloric intake-premeas foods	1		0	0
		1			0

Table III-2. Equipment Operations Analysis (Addendum B)

REF. NO.	EQUIPMENT ITEM (EU) / INVENTORY WT., PWR., VOL.	NO. REQ.	CREW USE TIME, MIN/X	EQUIP "ON" TIME, MIN/X	AVE PWR WATTS
026	Cage, Launch/re'entry (40)/ •				
	212B Prep for transfer to recovery vehicle-primate	256		*	*
071	Exerciser/ergomtr (prim) (42)/5, 0, 0.2				
	206B Vertebrate behavior study - primate	2		0	0
		2			0
072C	Feces vacuum sys-cage (40)/*				
	196B Primate cage prep - in space	7		*	*
		7			
076J	Flowmeter, gas (3)/ 0.4, 2, .002				
	401A Alveolar ventilation	42		10/wk	0
					0
076K	Flowmeter, doppler (31)/1], 0.01				
	324A Pulse wave velocity	1		135/2 wk	0
	325A Pulse wave contour	1		75/wk	0
	327A Respiratory vital capacity, etc.	1		120/2 wk	0
	415A Lung volumes	1		20/wk	0
		2			0
172	Spacesuit + 50 foot umbilical(11)/80, 1, 7				
	840B Max mass transportable-suited	12		60/wk	0
	841B Max vol. transportable-suited	12		60/wk	0
	842B Max MOI transportable-suited	12		60/wk	0
	843B Max mass alignable -suited	12		60/wk	0
	844B Max vol alignable -suited	12		60/wk	0
	845B Max MOI alignable -suited	12		60/wk	0
		12			0
180A	Trace gas concentrator (5)/10, 0, 0.25				
	059A Atmospheric ethylene monitoring	18		0	0
		18			0